Investigating the Relationship between the Facial Width-to-Height Ratio and Physical and Psychological Threat Potential

By

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Abstract

Individuals with large facial width-to-height ratios (FWHR) are judged as threatening and engage in threat-related behaviours. The aim of this thesis was to identify the specific components of threat potential related to the FWHR. In study 1, participants completed measures of psychological and physical threat potential. The FWHR correlated positively with aspects of physical threat potential in men and women, and an aspect of psychological threat potential in men. Additionally, study 1 investigated the extent to which these types of threat potential differentially predict aggression. In men only, psychological threat potential predicted non-costly aggression, and physical threat potential predicted costly aggression. In study 2, participants made inferences about the threat potential of participants from study 1. Results demonstrated an ability to infer threat potential from the face, and sex differences related to the definition of aggressiveness. Together, these findings demonstrate that the FWHR conveys two forms of threat potential in men, which differentially predict aggression.

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THE FACE RATIO AND THREAT POTENTIAL

An organism's threat potential is determined by both its propensity and its ability to cause harm (Parker, 1974). For example, a physically powerful animal that is particularly timid is lower in threat potential than a physically powerful animal that is particularly tenacious. This propensity to cause harm can be defined as an organism's psychological threat potential, whereas its ability to cause harm can be defined as its physical threat potential. Among conspecifics, the ability to assess rapidly both types of threat potential is vital for survival, as doing so provides an organism the ability to make timely flight or fight decisions (Bar, Neta, & Linz, 2006; Blanchard, Griebel, Pobbe, & Blanchard, 2011). Additionally, if an organism can effectively display its own threat potential, it can conserve resources and limit its exposure to direct conflict and physical harm, which increases its likelihood of survival (Maynard Smith & Harper, 2003). Thus, selection pressures should favour both the display and assessment of threat potential from physical markers.

Indeed, there is a wealth of literature on animal behaviour describing the various physical markers animals use to communicate their threat potential among conspecifics. Animals were shown to rely on signals such as sound (Wagner, 1989) and weaponry (Callander, Kahn, Maricic, Jennions, & Backwell, 2013) when deciding to fight or flee. There is also evidence that threat potential can be quickly and accurately assessed from static physical markers in a variety of distinct species. For example, paper wasps (*Polistes dominulus*) with more broken facial patterns engage in more dominant and aggressive behaviour (both attributes indicative of their threat potential) than do wasps with less broken facial patterns, and other wasps will typically avoid food sources guarded by wasps higher in threat potential (Tibbetts & Dale, 2004; Tibbetts & Lindsay, 2008). Great tits (*Parus major*) will approach aggressively conspecifics with narrower breast stripes, relative to their own, but will approach submissively conspecifics with

wider breast stripes, relative to their own (Järvi & Bakken, 1984). Female pipefish (*Syngnathus typhle*) use cross-striped patterns to deter same-sex rivals from mating (Berglund & Rosenqvist, 2009). These examples of animal behaviour demonstrate a variety of ways in which physical markings provide a cue of threat potential, and how conspecifics direct their attention to these signals to avoid danger.

Conflict has played a significant factor in our social development as a species (Choi & Bowles, 2007); archeological evidence demonstrates that interpersonal conflict is a staple of human ancestry (Walker, 2001). Thus, the same selection pressures that allow for the display and swift assessment of threat potential from physical markers in other species could also have afforded humans the ability to make rapid and accurate assessments of others' threat potential, as well as advertise their own threat potential. Doing so would reduce the risk of violence, injury, and death in environments that foster such happenings.

Judging Others from the Face

Our visual system automatically cues our attention to the face (Haxby, Hoffman, & Gobbini, 2000), thus, it is a likely candidate for the assessment of others. Indeed, humans can accurately derive a variety of information from the face such as sex, age, race and emotions (reviewed in Bruce & Young, 2012; McGugin & Gauthier, 2013), and the speed with which humans make theses inferences is rapid. Social judgements made in 39 ms of exposure time to a face are consistent with judgements made at 1000 ms (Bar, Neta, & Linz, 2006), and judgements made in 100 ms are consistent with judgements made without time constraints (Willis & Todorov, 2013). Although emotional expressions such as anger may help to inform an observer of another's intent (Ekman et al., 1987), they are not always displayed and can mask an individual's true intentions via deception, e.g., "a poker face". Further, emotional expressions are

not always reflective of an individual's typical disposition, and thus may lead to over/underestimations of a particular judgement. Thus, it would be advantageous for humans to make accurate assessments of others without a strict reliance on emotional expressions.

Indeed, research has demonstrated that individuals make numerous inferences about others without the aid of an emotional expression. Further, these judgements are consistent across observers, which suggests that individuals are using similar metrics to infer them, and, depending on the judgement, these inferences have some accuracy (see Berry, 1991; Zebrowitz, & Montepare, 2008). For example, judgements of warmth inferred from a facial photograph of an individual are consistent with perceptions of warmth from others who had been acquainted with the same individual for a nine-week period (Berry, 1990). Other judgements such as attractiveness, competency, and naivety, are examples of common inferences derived from the face and there are considerable consequences associated with each of these inferences. Attractive people are judged to be healthier and have better job opportunities (reviewed in Berry, 1991), and receive greater tips when working in restaurants (Parrett, 2015). Judgements of competency from facial photographs have predicted the results of US elections (Todorov, Mandisodza, Goren, & Hall, 2005). Individuals with 'baby faces' are judged to be more naïve, and are more likely to be exonerated for criminal acts deemed intentional but more likely to be sentenced for crimes of negligence (reviewed in Montepare & Zebrowitz, 1998). Taken together, these examples demonstrate how the face provides individuals with a variety of social information, which in turn informs how others perceive and interact with them.

Social judgements of physical strength and aggressiveness, key components of threat potential, are critically important in social interactions. Accurate inferences of these types of attributes from the face provide a person with appropriate information to guide their behaviour

when facing conflict. Research has provided some support that humans do possess an ability to derive such information from the face. For example, Sell and colleagues (2009a) showed that individuals are accurate at assessing the physical strength of others (who had previously been assigned a composite measure of strength – indexed by their performance on 4 weightlifting machines in one sample, and indexed by grip strength, bicep circumference, and self-reported strength in a second sample) from the face, and that observers' judgements of men's fighting ability correlated with their actual history of fights. Dabbs (1997) had participants rate photographs of individuals separated into low and high testosterone groups (there is a modest relationship between testosterone and aggression and dominance, for reviews see Archer, 2006; Carré & Archer, 2017) and found that the high testosterone group was judged to be higher in strength than the low testosterone group. Stillman, Maner, and Baumeister (2010) showed that observers' estimates of the likelihood of violence made from brief exposure to criminals' faces correlated with the criminals' history of violent offending. Other traits that might be relevant when assessing the threat potential of others include dominance, trustworthiness, and masculinity, all of which are consistently inferred by individuals from the face (see Geniole et al., 2015). Given that these findings show individuals can use the face to make somewhat accurate inferences about another individual's threat potential, it raises the question: which facial features do individuals rely on to infer these judgements of threat?

The Facial Width-to-Height Ratio (FWHR)

One facial metric has been thought to advertise the threat potential of another is the Facial Width-to-Height Ratio (FWHR), first identified by Weston, Friday, & Liò (2007). The FWHR consists of two measurements: a vertical measurement running between the mid-brow and upper lip and a horizontal measurement across the zygomatic, or cheek, bones of the face, and the width is divided by the height to obtain the FWHR (see Carré & McCormick, 2008).

Initially identified as sexually dimorphic (men > women, Weston et al., 2007), research findings have questioned this assertion (reviewed in Geniole et al., 2015). Nevertheless, the overall relationship between judgements of a person's threat potential and his/her FWHR, is stronger in men than in women (reviewed in Geniole et al., 2015). This difference may be because women are not perceived to be as aggressive as men, and because men engage in more direct aggression than do women (reviewed in Archer, 2004). The type of behaviour and attributes reflective of greater threat potential as they relate to the FWHR will be discussed in the next section.

The FWHR and Behaviour

The seminal research associating the FWHR with threat potential investigated the relationship between the FWHR with aggression (Carré & McCormick 2008). In one study, men with larger FWHRs were more likely to be behave aggressively on the Point-Subtraction-Aggression-Paradigm (PSAP; a well validated measure of aggression, reviewed in Geniole, MacDonell, & McCormick, 2016), compared to men with smaller FWHRs, and this relationship was not found in women (Carré & McCormick 2008). Additionally, in two studies in which aggression was operationalized as the number of penalty minutes someone receives during a hockey game, in both a varsity and professional sample of male hockey players, the FWHR positively correlated with penalty minutes, providing strong ecological validity for the relationship between the FWHR and aggression (Carré & McCormick 2008). Further validating these findings, recent research has shown that, in men, the FWHR positively correlates with self-reports of aggression (e.g., Lefevre, Etchells, Howell, Clark, & Penton-Voak (2014). Although these findings suggest that the FWHR is associated with a greater willingness to engage in violent conflict, they are limited to North American samples and modern environments. However, earlier research on bushmen from Namibia revealed that those who had facial scars as

a result of interpersonal violence had wider faces than those who did not report receiving their scars from interpersonal violence (Christiansen & Winkler, 1992), demonstrating that these findings are not limited to Western cultures.

Additional research has investigated the relationship between the FWHR and other forms of behaviour and attributes indicative of greater threat potential, such as deception, cheating, dominance, and formidability. Stirrat and Perrett (2010) found that men with larger FWHRs were more likely to exploit the trust of others in an economic game compared to men with smaller FWHRs. Haselhuhn and Wong (2012) found that men with larger FWHRs were more likely to deceive their partner during a negotiation, and were more likely to lie about the number of ballots they entered in a lottery than men with smaller FWHRs. This finding regarding cheating behaviour in a lottery task was replicated using a methodology less susceptible to confounds (Geniole, Keyes, Carré, & McCormick, 2014) Research from both Lefevre et al. (2014), and Mileva, Cowan, Cobey, Knowles, and Little (2014) found a significant correlation between the FWHR and self-reported dominance in men. Stirrat, Stulp, and Pollet (2012) examined a large sample of skulls and found that men with larger FWHRs were less likely to have died from contact violence than men with smaller FWHRs, suggesting greater physical formidability for men with larger FWHRs. Further, recent investigations on large samples of professional male fighters (mixed martial artists) revealed that fighters who were more successful (e.g., won more fights, had longer careers) also had larger FWHRs than did professional fighters with smaller FWHRs (Zilioli et al., 2015; Třebický et al., 2015).

Despite these findings, other research has cast doubt on the validity of the link between threat potential and the FWHR. For example, Deaner, Goetz, Shattuck, and Schnotala (2012) suggested that penalty minutes in hockey games are more readily explained by body weight and

not the FWHR, and Özener (2012) found no relationship between self-reports of aggression and the FWHR among a Turkish sample. To help clarify the conflicting findings between the FWHR and aggression, Haselhuhn, Ormiston, and Wong (2015) conducted a meta-analysis and found a small, but significant, effect size between the FWHR and aggression in men (r = .11). A second meta-analysis was conducted that incorporated the breadth of research on the FWHR and threat potential (Geniole et al., 2015). Geniole and colleagues (2015) investigated the link between the FWHR and aggression, and also included dominance, threat, masculinity and attractiveness and how the relationship between the FWHR and all mentioned attributes was affected by both sex and study design. Thus, this meta-analysis provided a richer test of the hypothesis that the FWHR is linked perceptually and behaviourally with threat potential. The meta-analysis revealed a significant relationship between the FWHR and dominant behaviour in both sexes (r =.12), and a significant relationship between the FWHR and threatening behaviour in men, (r = .16). Thus, the FWHR appears to share a small but consistent relationship with threat potential.

There is also research demonstrating an association between BMI and the FWHR (e.g., Coetzee, Chen, Perrett, & Stephen, 2010; Třebický et al., 2015), which would be indicative of greater threat potential as larger individuals have a natural advantage during physical confrontation. The meta-analysis of Geniole and colleagues (2015) revealed that the FWHR and BMI are significantly and positively correlated (r = .31) across both sexes. This relationship between body size and the FWHR may appear to call into question the validity of the FWHR as an independent cue of threat potential; nevertheless, much of the research linking the FWHR with threat controlled for body weight (e.g., fighter success in Ziloli et al., 2015). Regardless, the relationship between the FWHR and physical size is evidence that individuals with larger FWHRs are higher in physical threat potential than men with smaller FWHRs, although physical

size is not perfectly correlated with physical strength or fighting ability.

If our sensory systems have evolved to detect threat potential from the FWHR, then other animals that share a similar genetic makeup and evolutionary history may also show similarities in their perceptual mechanisms. Such research is scarce. One study found that brown capuchin monkeys with larger FWHRs were more dominant and assertive than were brown capuchin monkeys with smaller FWHRs (Lefevre et al., 2014). Another study found that FWHRs were larger in more dominant species of macaques compared to more tolerant species of macaques (Borgi & Majolo, 2016). These findings in non-human primates support the evolutionary explanation for the positive relationship between the FWHR and threat potential.

Taken together, research supports the claim that the FWHR is a cue of threat potential in humans more so in men than women. However, physical markers that are indicative of behaviour are not viable unless we cue our attention to them at some level of processing.

The FWHR and Perception

Investigation into how others perceive individuals with larger FWHRs has found a consistent relationship in men between the FWHR and judgements that would be indicative of greater threat potential, such as aggressiveness. For example, Carré, McCormick and Mondloch (2009) had participants' rate the aggressiveness of faces of men for which a behavioural measure of aggression had previously been obtained. Participants' judgements of aggression were highly correlated with both actual aggression scores and with the FWHR, suggesting that individuals use the FWHR to make accurate assessments about others threat potential.

This relationship between perceptions of aggressiveness and the FWHR is robust, and has been demonstrated consistently across numerous studies using different stimulus sets, age ranges, and ethnicities (reviewed Geniole et al., 2015). For example, Short and colleagues (2012)

had 8-year-old Chinese and Canadian Caucasian children rate the aggressiveness of adults from both the same and opposing ethnicity and found that men with larger FWHRs were rated higher in aggressiveness than were men with smaller FWHRs by both groups irrespective of the ethnicity of the faces. Furthermore, the relationship between the FWHR and participants' ratings of aggressiveness holds when faces are cropped or blurred to mask facial features while leaving the FWHR intact (Carré, Morrissey, Mondloch, & McCormick, 2010). Additionally, unlike other facial metrics associated with judgements of threat such as jaw size, the relationships between judgements of aggressiveness and the FHWR persist even when men are bearded (Geniole & McCormick, 2015). Nevertheless, judgements of aggressiveness are stronger in younger versus older faces (Hehman, Leitner, & Freeman, 2014), possibly because younger individuals (especially males) are known to engage in more risky and dangerous behaviour than are older individuals (Wilson & Daly, 1985). Thus, it is potentially problematic when asking others to infer judgements of threat potential from older faces, as markers of threat (e.g., the FWHR) are dampened by the age of the face in question, such that older faces are rated as less threatening regardless of the size of their FWHR (Hehman et al., 2014).

There is also evidence that observers' assessment of men based on the FWHR influence observers' actions, which have both positive and negative consequences. Consistent with evidence that men with larger (rather than smaller) FWHRs are judged to be less trustworthy, research shows that others act more selfishly when deciding how to allocate resources to them (Haselhuhn, Wong, & Ormiston, 2013; Stirrat & Perrett, 2010). However, when selecting partners for a competition, individuals are more likely to select men with larger, rather than smaller FWHRs - an effect driven by inferences of threat potential (Hehman, Leitner, Deegan, & Gaertner, 2015).

The positive and negative consequences associated with being deemed more threatening was recently explored in economic bargaining paradigms (Geniole, MacDonell, & McCormick, 2016). Using online interactions, participants were asked to propose monetary offers to a series of facial photographs. In conditions where the threat of retaliation was present (i.e., the participants offer could be rejected), participants awarded more money to individuals with larger FWHRs, (i.e., those higher in threat potential), but in conditions where the threat of retaliation was not present, (i.e., the participants offer could not be rejected), participants awarded less money to individuals with larger FWHRs, (i.e., those lower in threat potential). This effect was also moderated by the proposers' own physical threat potential, such that those lower in physical threat potential were more sensitive to cues of threat in others (Geniole et al., 2016). Taken together, the results from these studies demonstrate positive and negative consequences for individuals deemed higher in threat potential.

The Present Study

As described earlier, threat potential involves both physical and psychological threat. The extent to which the FWHR cues either or both psychological or physical threat is unknown. Although the reviewed literature suggests a link between the FWHR and both physical threat potential (e.g., BMI) and psychological threat potential (e.g., individuals more willing to deceive), the behavioural outcomes associated with the FWHR could be a by-product of either category of threat potential. For example, the research linking the FWHR with professional fighter success (Zilioli et al., 2015; Trebicky et al., 2015) could be a result of the fighter's physical prowess or their tenacity. The aim of this thesis was to address this ambiguity surrounding the FWHR and its relationship with threat potential. Moreover, this thesis investigated whether components of physical and psychological threat potential can uniquely

predict two types of aggression, costly reactive and non-costly reactive.

Study 1 investigated how the FWHR was related to physical and psychological threat potential and how threat potential can predict aggressive behaviour that is either costly or non-costly to the participant. Study 2 investigated how observers' judgements of physical and psychological threat potential are related to the FWHR, and how these judgments are related to the actual strength and aggression of participants from study 1. Participants' physical threat potential was measured using flexed bicep circumference, grip strength, and self-report strength (Sell, 2009). Participants' psychological threat potential, was measured using four self-report questionnaires designed by Sell and colleagues (2009): anger proneness, entitlement, utility of personal aggression, and success in conflict. To measure costly aggression, the the Point Subtraction Aggression Paradigm was used (PSAP; reviewed in Geniole et al., 2016), and to measure non-costly aggression a money allocation task was used (first implemented in Geniole, Busseri, & McCormick, 2013 and modelled after the hot sauce paradigm, see McGregor et al., 1998). It was predicted that relationships with the FWHR would be stronger in men than in women.

Methods – Study 1

Participants

The final sample consisted of 154 participants (78 women, 76 men, M_{age} = 20.03 years, SD_{age} = 2.11, age range: 17-29 years; 74% white, 26% non-white) who were recruited through Brock University's undergraduate research pool (SONA) and had the opportunity to receive either course credit or monetary compensation ($5) for their participation. All participants provided informed consent, except for 17 participants who opted not to get photographed but

consented to, and completed other parts of the study. All procedures were approved by Brock University's Research Ethics Board (see Appendix A)

Measures

Psychological threat potential. Psychological threat potential is a multifaceted construct; in this thesis it is defined as the propensity to cause harm. As anger proneness and entitlement have predicted aggressive behaviour (e.g., Deffenbacher, Deffenbacher, Lynch, & Richards, 2003; Reidy, Zeichner, Foster, & Martinez, 2008), they are considered facets of psychological threat potential. Psychological threat potential was assessed with four questionnaires designed by Sell and colleagues (2009): anger proneness (21-item, $\alpha = .85$; e.g., "I have a short fuse"), entitlement (15-item, $\alpha = .63$; e.g.; "I am better than most people"), belief in the utility of personal aggression (16-item, $\alpha = .77$; e.g., " If I don't fight back, people will walk all over me"), and belief about success in conflict (7-item, $\alpha = .82$; e.g., "Other people know not to get in my way"; see Appendix E).

Physical threat potential. Physical threat potential refers to an individual's physical strength and size. It is defined in this thesis as the physical characteristics that promote the likelihood of winning an interpersonal contest, i.e. the ability to cause harm. Physical threat potential was assessed with three different measures – flexed bicep size, grip strength, and self-reported strength. Flexed bicep size was measured by asking participants to flex their dominant arm while the researcher measured the circumference of the bicep using a tape measure. Grip strength was measured using a hand dynamometer, and self-reported strength was assessed using the question "I am physically stronger than ___% of others of my sex". These measures positively correlate with upper body strength, and bicep circumference shares the strongest correlation with actual lifting strength, $r = .74$ (see Sell, 2005).

Costly reactive aggression. To assess costly reactive aggression, participants were administered a version of the Point Subtraction Aggression Paradigm (PSAP), originally designed by Cherek (1981; Allen, Dougherty, Rhoades, & Cherek, 1996). It is a well-validated measure of reactive aggression, positively correlating with other measures of aggression (e.g. Buss-Perry Aggression Questionnaire, reviewed in Geniole, MacDonell, McCormick, 2016). The PSAP is a computerized task in which a participant must respond by key press to earn, protect his/her own, or steal a fictitious (same-sex) partner's points. Participants are instructed that the goal of the task is to earn as many points as possible, as the points redeemed will later be exchanged for money. Participants are presented with three different response options during the task: (1) press the "1" key on the keyboard 100 times to earn 1 point; (2) press the "2" key 10 times to steal 1 point from the fictitious partner; or (3) press the "3" key 10 times to protect their own points from being stolen for a variable amount of time (0-45 seconds). All participants had a point stolen from them after the first 45 seconds to provoke potential aggressive responses. Although participants may steal points from the fictitious partner, they are unable to redeem stolen points. Thus, engaging in option 2 is costly to participants in terms of their own point earnings, as it will minimize the amount of available time for point redemption. The length of time, number of button presses requirements, and the number of rounds of the PSAP has varied across studies, based on evidence that reductions from one to three rounds, as well as reductions in the duration of the complete task, do not affect the validity of the PSAP (Golomb et al., 2007; Bailly & King, 2006; Geniole et al., 2016). The current study implemented a version consisting of one, five-minute round and involved all three response options.

Given that the act of stealing a point from another is thought to be motivated by an intent to harm (a harm that the victim would rather avoid), it fulfills the definition of aggressive

behaviour (Baron & Richardson, 1994), rendering the PSAP an appropriate measure of aggression. Further, as previously mentioned, engaging in option 2 (point stealing) is considered costly aggression because participants sacrifice time that could be allotted to earning money in order to retaliate against the fictitious partner. Reactive aggression was calculated as the percentage of option 2 presses that occurred after the first point was stolen from the participant. We used percentage instead of total to control for participants speed of responding.

Post-PSAP questionnaire. After completing the PSAP participants filled out a brief questionnaire asking them to provide thoughts about their competitor, and general comments about their experience with the PSAP (see Appendix D). This questionnaire was used to assess the believability of the fictitious competitor. Four participants (three women, one man, 2% of total sample) provided responses suggesting they were suspicious of their opponent's existence. Two of these participants had already been removed from analyses for being outliers: one women for being an outlier on weight, and one man for being an outlier on age (see statistical analysis). The removal of the remaining two participants did not affect the results, and they were kept in analyses.

Non-Costly Reactive Aggression. After the PSAP, participants completed the post-PSAP questionnaire and were informed by a research assistant that because the other participant stole from them so frequently they had not earned any money. This statement served as another provocation.

The participant was then informed that he/she would now decide how much money the fictitious participant would receive (up to $5.00). To do so, the participant was given a sheet of paper that contained a continuum with $0 depicted on one end, and $5.00 on the other (see Appendix F) and they were asked to place a line anywhere along the continuum to approximate

how much money they wanted the other participant to receive. Participants were assured that their responses would be kept strictly confidential and that the other participant would not know their identity; therefore, this allocation task was considered a measure of non-costly reactive aggression because if the participant chose to aggress, he/she would not be confronted with any threat of retaliation, nor would his/her decision to aggress result in any personal cost. After the participant made his/her decision, the research assistant collected the sheet of paper. Non-costly reactive aggression was calculated by measuring in millimetres how far each participant's dash was from the $5.00 endpoint (closer to 0, more aggressive).

FWHR. To measure the FWHR of participants, each was photographed with a digital camera and was instructed to wear a hairnet, face forward, and pose with a neutral expression. ImageJ (NIH open source software) was used to measure the distance between the mid-brow and the upper-lip (vertical measurement), and the distance across the zygomatic bones of the face (horizontal measurement). Participants' FWHR was calculated by dividing the horizontal measurement from the vertical measurement (see Weston et al., 2007).

Procedure

Participants took approximately one hour to complete study 1. Upon arrival, participants were greeted by a research assistant and taken to a room where they completed four questionnaires assessing psychological threat potential (see Appendix E). After 15 minutes, the research assistant returned, collected the questionnaires, and measured participants' physical threat potential via a number of different measures previously discussed. The researcher also collected a saliva sample from each participant for a set of unrelated hypotheses. Participants were then given instructions to complete the PSAP. More specifically, participants were instructed that they would be playing a computer game simultaneously with another participant,

and that the goal was to earn as many points as possible. Participants were instructed that the points they earned would be exchangeable for money. Each response option was explained to the participant and questions were used to ensure they understood the task, e.g. "do you get to keep the points you steal"? Participants then completed a 1-minute practice PSAP session, in which none of their points were stolen. Afterwards, the researcher left the room and the participant completed the formal PSAP game.

The research assistant then returned to the testing room and the participant was given the post-PSAP questionnaire to complete. The research assistant left the room to give the impression that he/she was reviewing the fictitious participant's PSAP score. When the research assistant returned, the participant was told he/she had not earned points because they had been stolen by his/her opponent, and the participant completed the money allocation task. After, each participant provided a second saliva sample (again, concerning a set of unrelated hypotheses), then was debriefed and a photograph of his/her face was taken.

Statistical analysis

There were 17 participants (Women = 8, Men = 9) who did not consent to have a photograph of their face taken and were thus removed from analyses. After checking for outliers (+/- 3 SD's from the mean) independently for both sexes on all measures, an additional five participants (two men, three women) were eliminated from analyses for being outliers on weight (so as to minimize effects of high weight on measures such as bicep circumference), and five participants (three men, two women) were eliminated for being outliers on age. In total, 169 participants (Women = 88, Men = 81, M_{age} = 20.11) were used in analyses for study 1a.

Study 1a: Association of FWHR with physical and/or psychological threat potential.

Preliminary analyses involved ANOVAs and t-tests, and detected differences on several

measures based on ethnicity and/or sex (see Table 1). Thus, all analyses were conducted separately for each sex, controlling for ethnicity (participants were coded as either white, or non-white). Partial correlations (controlling for ethnicity) were conducted between the FWHR and our measures of physical threat potential (bicep circumference, grip strength, self-report strength) and psychological threat potential (four questionnaires). We then ran a linear regression, split by sex, with the FWHR as the dependent variable and simultaneously entered our measures of physical and psychological threat potential, and ethnicity (see preliminary analysis for study 1), as the independent variables.

Study 1b: Relationship between physical and psychological threat potential and aggression. A mistake by a research assistant led to 12 participants (eight women, four men) being run on an incorrect version of the PSAP and they were subsequently dropped from analyses. We checked for outliers independently (+/- 3 SD's) for both sexes on reactive and proactive PSAP aggression, which resulted in the removal of an additional three participants (two women, one man). In total, 154 participants (Women = 78, Men = 76) were included in analyses pertaining to study 1b. This was the final N reported in the participant section.

The first aim was to investigate if physical and psychological threat potential differentially predict aggressive behaviour. To investigate this aim, linear regressions were conducted to predict costly reactive aggression and non-costly reactive aggression, entering bicep circumference, anger proneness, and ethnicity simultaneously as independent variables in both. Bicep circumference and anger proneness were selected because they were the measures of threat potential that positively correlated with the FWHR, in men. Additionally, a linear regression was conducted to investigate whether the FWHR predicted either costly and non-costly aggression, without entering bicep circumference and anger proneness as predictors.

Results - Study 1

Preliminary analyses

A two-factor ANOVA revealed a significant interaction between sex and ethnicity on the FWHR ($F(1,165) = 10.11$, $p = .002$). In men, non-white participants had larger FWHRs than white participants ($t(79) = 2.67$, $p = .01$, $d = .63$). The difference was in the opposite direction and not significant in women ($t(86) = -1.76$, $p = .08$, $d = .47$). Men and women differed on the size of their bicep ($t(167) = -11.65$, $p < .001$, $d = 1.78$), grip strength ($t(167) = -14.77$, $p < .001$, $d = 2.25$), entitlement ($t(167) = -3.01$, $p = .003$, $d = .46$), and their belief about the utility of aggression, ($t(167) = -4.77$, $p < .001$, $d = .73$), such that men had significantly higher scores for each. As a result of these analyses, analyses were split by sex, and ethnicity was controlled for all analyses pertaining to study 1.

Study 1a: Does the FWHR correlate with physical or psychological threat potential?

Using partial correlations to control for ethnicity, in women, the FWHR was positively associated with bicep circumference ($r = .38$, $p > .001$), but not with other measures of threat potential (see Table 2). In men, the FWHR also was positively associated with bicep circumference ($r = .23$, $p = .037$), and anger proneness ($r = .32$, $p = .004$), but not with other measures of threat potential (see Table 2). Results from regression analyses revealed that in women, the FWHR was predicted by bicep circumference ($\beta = .341$, $p = .002$, 95% CI [0.005, 0.024]) when controlling for the effects of all other measures and ethnicity. In men, both bicep circumference ($\beta = .255$, $p = .048$, 95% CI [0.002, 0.022]) and anger proneness ($\beta = .394$, $p = .003$, 95% CI [0.014, 0.112) predicted the FWHR when controlling for the effects of all other measures. In men, ethnicity ($\beta = -.318$, $p = .004$, 95% CI [-0.158, -.0.015]) also remained a significant predictor of the FWHR when controlling for the effects of all other measures.

Study 1a: Association between measures of psychological and physical threat

In men, the correlations between measures of physical and psychological threat potential were all non-significant (*p*s > .05), except for a significant negative correlation between grip strength and anger proneness (*r* = -.25) and a significant positive correlation between self-reported strength and success in conflict (*r* = .24). In women, the correlations between measures of physical and psychological threat potential were all non-significant (*p*s > .05) except for a positive correlation between self-reported strength and anger proneness (*r* =.23) and a positive correlation between grip strength and success in conflict (*r* = .23).

Table 1

Descriptive statistics of participants in Study 1.

	Women				Men				Sig Effects
	White (n = 66)		Non-white (n = 22)		White (n = 57)		Non-white (n = 24)		
	M	SD	M	SD	M	*SD*	M	SD	
FWHR	1.81	0.13	1.76	0.11	1.81	0.14	1.91	0.16	I
BIC	28.82	2.77	29.08	3.21	34.74	3.85	35.57	4.02	S
GRIP	28.63	4.70	28.31	4.82	45.75	9.02	41.84	8.27	S
SRS	43.44	22.93	38.82	22.27	48.29	19.68	47.00	20.81	
ANG	3.65	0.80	3.95	0.61	3.92	0.73	3.72	0.96	
ENT	3.71	0.64	3.94	0.53	4.05	0.67	4.08	0.61	S
CON	3.89	0.94	4.21	0.85	3.94	1.02	4.35	0.99	
UTIL	3.35	0.66	3.45	0.61	3.90	0.71	3.84	0.78	S

*N*ote. I = significant interaction. S = significant sex differences. FWHR = facial width-to-height ratio. BIC = bicep circumference. GRIP = grip strength. SRS = self-report strength. ANG = anger proneness. ENT = entitlement. CON = success in conflict. UTIL = utility of personal aggression.

Table 2

Correlations between the fWHR and measures of psychological and physical threat, controlling for ethnicity (Study 1) in men (shaded grey cells) and women (white cells).

		Physical Threat			Psychological Threat			
	FWHR	BIC	GRIP	SRS	ANG	ENT	CON	UTIL
FWHR	-	**0.376**	0.135	**0.226**	-0.018	-0.184	-0.085	0.04
BIC	**0.234**	-	**0.337**	**.347**	0.044	-0.013	0.178	0.099
GRIP	-0.162	0.392	-	.113	-0.102	0.028	**0.227**	-0.048
SRS	0.106	**0.550**	**0.361**	-	**.228**	-.009	0.13	0.125
ANG	**0.317**	-0.063	**-0.249**	-0.064	-	**0.20**	**0.266**	**0.506**
ENT	-0.002	-0.025	0.025	0.196	**0.338**	-	**0.416**	0.158
CON	0.011	-0.050	0.001	**0.242**	0.116	0.213	-	0.173
UTIL	0.119	0.024	-0.065	0.135	**0.569**	**0.419**	**0.354**	-

Note. N (Women = 88, Men = 81). Significant correlations ($p < .05$) are in bold font. FWHR = facial width-to-height ratio. BIC = bicep circumference. GRIP = grip strength. SRS = self-report strength. ANG = anger proneness. ENT = entitlement. CON = success in conflict. UTIL = utility of personal aggression.

Study 1b: Does psychological or physical threat potential better predict aggression?

FWHR and aggressive behaviour. In women, the FWHR predicted costly reactive aggression when controlling for ethnicity (β = .245, 95% CI [1.085, 23.318], p = .032). In men, the FWHR did not predict costly reactive aggression when controlling for ethnicity (β = .196, 95% CI [-1.667, 16.547], p = .108), although it approached significance.

In women, the FWHR did not predict non-costly reactive aggression when controlling for ethnicity (β= -.066, p = .57). In men, the FHWR did not predict non-costly reactive aggression when controlling for ethnicity ($b\beta$= .064, p = .604).

Costly Reactive Aggression (PSAP). In women, there was no significant main effect of bicep circumference (β = .104, p = .36, 95% CI [-0.253, 0.068]), anger proneness (β = -.131, p = .26, 95% CI [-2.988, 0.826]), or ethnicity (β = -.179, p = .13, 95% CI [-5.866, 0.737]) on costly reactive aggression. In men, there was a significant main effect for bicep circumference (β = .288, p = .01, 95% CI [0.099, 0.791]) on costly reactive aggression, such that men with larger biceps were more aggressive than men with smaller biceps, but there was no significant effect of anger proneness (β = .130, p = .254, 95% CI [-0.674, 2.511]) or ethnicity (β = -.037, p = .75, 95% CI [-3.302, 2.379]).

Non-Costly Reactive Aggression (Money allocation task). In women, there was no significant main effect of anger proneness (β = .193, p = .10, 95% CI [-1.398, 16.404]), bicep circumference (β = .038, p = .74, 95% CI [-1.816, 2.547]), or ethnicity (β = -.13, p = .27, 95% CI [-24.080, 6.736]) on non-costly reactive aggression. In men, there was a significant main effect of anger proneness (β = .35, p = .002, 95% CI [6.322, 27.471]), such that men higher in anger proneness allocated significantly less money than men lower in anger proneness, but no main effect of either bicep circumference (β = .014, p = .90, 95% CI [-2.148, 2.450]) or ethnicity (β = -.081, p = .47, 95% CI [-25.760, 11.970]) on non-costly reactive aggression.

Study 1 Summary

Despite previous work indicating a positive association between physical and psychological threat potential, no such association was found. The FWHR was associated with aspects of physical threat potential in women, and aspects of psychological and physical threat potential in men. Specifically, bicep size was associated with the FWHR in both men and women and anger proneness was associated with the FWHR in men only. Further, each type of threat potential differentially predicted aggressive behaviour in men. An aspect of physical threat potential predicted costly-aggression, whereas and aspect psychological threat potential predicted non-costly aggression. Based on these results, and because FWHRs and behavioural measures of aggression were obtained from participants in study 1, a second study was conducted to investigate whether observers (a new set of participants) could assess threat potential and aggression from the faces of previous participants.

Methods - Study 2

Participants

The final sample consisted of 106 Participants (59 women, 47 men, M_{age} = 20.84 years, SD_{age} = 5.2, age range: 17-52 years; 72.6% White, 5.7% Asian, 6.6% Black, 15.1% other), recruited using Brock University's undergraduate research pool (SONA). Each participant had the opportunity to receive either course credit or monetary compensation ($5) for their participation. All participants provided informed consent and all procedures of Study 2 were approved by Brock University's Research Ethics Board (see Appendix A).

Stimuli for Study 2

Selection of faces from participants from study 1 was limited to those who had consented to have their photographed used in future research. Furthermore, because the

relationship between the FWHR and both threatening behaviour and the perceptions of threat are stronger and more consistent in men than women (reviewed in Geniole et al., 2015) selection was limited to male participants from study 1. To avoid biases in threat and physical judgements related to ethnicity (e.g., Wilson, Hugenberg, & Rule, 2017) and age (e.g., Hehman, 2014) we selected only white participants under the age of 30. In total, photos of 43 participants from study 1 were used as stimuli in study 2. Each photo was adjusted to a hairline-chin distance of 400 pixels, presented in greyscale on a black canvas, and cropped so only the face was showing (see figure 1 for examples).

Figure 1. Examples of stimuli with small and large FWHRs used in study 2.

Procedure

Study 2 involved a test session of approximately 15 – 20 minutes in length. Upon arrival, participants were directed to a separate testing room. Next, participants were asked to provide ratings for a series of faces. Participants were assigned to one of three conditions (Condition 1: n = 35; 20 women, 15 men, Condition 2: n = 35; 20 women, 15 men, Condition 3: n = 36; 19 women, 17 men): condition 1 whereby they were asked to provide ratings of strength for each face, after which they rated each face on aggressiveness, condition 2 whereby they provided

ratings of anger proneness for each face after which they rated each face on aggressiveness, and condition 3 whereby they provided ratings of aggressiveness for each face and after which they rated each face on anger proneness. Participants used a 7-point Likert scale for all ratings (e.g., from 1 “not at all aggressive/strong/anger prone” to 7 “very aggressive/strong/anger prone”). The main research questions in this study were addressed using only the ratings of the characteristics first provided by the participants because of order effects. Nevertheless, secondary analyses were conducted with all the ratings.

Using E-Prime software, participants were shown faces of participants from Study 1 (n = 43) presented on a black background, one at a time, and in random order. Each face appeared for 2000 ms, followed by a sentence on a black screen asking, “How strong (or anger prone or aggressive) did that person look”? Participants had unlimited time to make their responses but were instructed to use their gut instincts and to provide each rating as quickly as possible. Once participants finished rating the first set of faces, they completed the same procedure for the second type of rating for their experimental condition. In total, participants rated 86 images (43 facial identities) across two blocks. Each face appeared once in each block, and the order within each block was randomized. After rating the faces, participants provided their age, sex, and ethnicity, and they were questioned regarding their familiarity with the photographed identities. No participant reported recognizing any of the identities.

Statistical Analysis

Bivariate correlations were run to assess the association among ratings, ratings and their relationship with the FWHR, and ratings and their association with the actual anger proneness aggressive behaviour, and bicep circumference of the participants in the stimuli set. Paired samples *t*-test were used to assess sex differences in perception ratings. Linear regressions were

used to assess whether ratings of strength and aggressiveness predicted the FWHR for men. As which characteristic is rated first can influence subsequent ratings, we focused our analyses on the group differences and associations among the three ratings that were rated first. Paired sample *t*-tests were used to determine the difference scores for what was rated first versus what was rated second, for both men and women.

Results – Study 2

How are observers' judgements of threat related to the FWHR?

Descriptive statistics can be found in Table 3. All correlations within sex can be found in Table 4 and correlations between sex can be found in Table 5.

Associations among the ratings. For women, ratings of anger proneness were highly associated with ratings of aggressiveness ($r = .88$, $p < 0.001$), and modestly associated with those of strength ($r = .38$, $p = 0.01$), and ratings of strength were modestly associated with ratings of aggressiveness ($r = .39$, $p = 0.01$). For men, ratings of anger proneness were modestly associated with ratings of aggressiveness ($r = .34$, $p = 0.03$) and with those of strength ($r = .35$, $p = 0.02$), and ratings of strength were highly associated with ratings of aggressiveness ($r = .87$, $p < 0.001$).

Ratings and the FWHR. For women, the FWHR was correlated significantly with participant's ratings of aggressiveness ($r = .39$, $p = 0.01$), and not with anger proneness ($r = .296$, $p = .054$) or strength ($r = .17$, $p = 0.28$). For men, the FWHR was correlated significantly with their ratings of aggressiveness ($r = .303$, $p = 0.048$) and strength ($r = .41$, $p = 0.007$), and not with anger proneness ($r = .22$, $p = .15$). When both ratings of aggressiveness and strength were entered as predictors of the FWHR in a linear regression, the overall model was significant, ($F(2,40) = 4.2$, $p = .02$); the partial correlations for strength (partial $r = .30$) and aggressiveness (partial $r = -.11$) were reduced compared to the zero-order correlations.

Ratings and actual anger proneness, aggression, and strength. Women's ratings of strength (r = .44, p = 0.003) and men's ratings of anger proneness (r = .37, p = 0.015) were correlated with bicep circumference. Women's ratings of anger proneness and of aggressiveness had the highest association with actual anger proneness, but the associations did not meet statistical significance (both rs = .289, p = 0.06). Men's ratings of strength (r = .304, p = 0.05) and of aggressiveness (r = .33, p = 0.03) were associated with actual anger proneness. Women's ratings of anger proneness (r = .38, p = 0.01), strength (r = .32, p = 0.035), and of aggressiveness were positively correlated with costly aggression (r = .289, p = 0.06). Men's ratings of strength (r = .34, p = 0.03) and of aggressiveness (r = .37, p = 0.02) were associated with costly aggression. None of the women's or men's ratings were associated with non-costly aggression (all rs < .22).

Strength of the relationships observed. For women, in every instance, what was rated first differed significantly from what was rated second (all ps < 0.003). Nevertheless, the correlations among the three groups of aggression ratings were high (all rs > .90), as was the correlation between the two ratings of anger proneness (r = .87). For women, ratings of aggressiveness were associated with the FWHR irrespective of whether rated first or second (all rs > .40, and the association between ratings of anger proneness and the FWHR that missed statistical significance when rated first was significant when rated second (r = .48, p = 0.001). The associations between actual measures and perceived measures rated second were similar to those for perceived measures rated first (see Table 4).

For men, in every instance, what was rated first differed significantly from what was rated second (all ps < 0.04). Nevertheless, the correlations among the three groups of aggression ratings were high (all rs > .79), although the correlation between the two ratings of anger

proneness was weaker (r = .37, p = 0.02). For men, ratings of aggressiveness were associated with the FWHR irrespective of whether rated first or second (all rs > .30), and the association between ratings of anger proneness and the FWHR that missed statistical significance when rated first was significant when rated second (r = .31, p = 0.04).

Study 2 Summary

The results from Study 2 demonstrated that the meaning of aggressiveness differs between men and women, such that men associate aggressiveness more so with strength than anger and women associate aggressiveness more so with anger than strength. The FWHR was associated with participants ratings of aggressiveness and, in men, strength. Additionally, the FWHR and ratings of strength and anger proneness were all in the expected direction. Lastly, both men and women demonstrated a modest ability to infer aspects of physical and psychological threat potential from the face. These results and their implications are discussed in the following section.

Table 3

Descriptive Statistics of participants in study 2.

		M	SD
Stimuli (n=43)	FWHR	1.80	0.11
	Bicep Circumference	34.65	3.59
	Anger Proneness	3.80	0.70
	PSAP Aggression	9.31	8.26
	Money Allocation	22.30	34.21
Women's 1st Rating	Perceived Anger	2.99	0.79
	Perceived Aggressiveness	3.58	0.92

	Perceived Strength	4.08	0.70
	Perceived Anger	3.95	0.80
Men's 1st Rating	Perceived Aggressiveness	2.99	0.71
	Perceived Strength	3.49	0.74

Table 4

Correlations from study 2, within sex.

	Actual Traits/Measures					When rated 1st		
	FWHR	BIC	AP	PSAP AGG	MNY AGG	ANG1	AGG1	STR1
FWHR	-	0.193	**.321***	-0.003	**.347***	0.296	**.391****	0.17
BIC	0.193	-	-0.03	0.025	0.122	0.053	0.009	**.444****
AP	**.321***	-0.025	-	0.226	**.480****	0.289	0.289	0.215
PSAP AGG	-0.003	0.025	0.23	-	0.071	**.378***	0.289	**.322***
MNY AGG	**.347***	0.122	**.480****	0.071	-	0.215	0.214	0.181
ANG1	0.224	**.369***	0.13	0.146	0.11	-	**.880****	**.379***
AGG1	**.303***	-0.06	**.325***	**.366***	0.067	**.341***	-	**.394****
STR1	**.405****	0.021	**.304***	**.341***	0.139	**.346***	**.872****	-

Note. Results for female raters (white cells) can be found in the top-right triangle; results for male raters (grey cells) can be found in the bottom-left triangle. FWHR = facial width-to-height ratio. BIC = bicep circumference. AP = anger proneness. PSAP AGG = costly reactive aggression. MNY AGG = non-costly reactive aggression. ANG1 = anger judgements AGG1 = aggressiveness judgements. STR1 = strength judgements

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 5

Correlations of the ratings from study 2, between sex.

		Women		
		ANG1	AGG1	STR1
Men	ANG1	0.261	0.350*	0.870**
	AGG1	0.859**	0.892**	0.450**
	STR1	0.836**	0.900**	0.437**

Note. ANG1 = anger proneness, rated first. AGG1 = aggressiveness, rated first. STR1 = strength, rated first. ANG2 = anger proneness, rated second (aggressiveness, rated first). AGG2 = aggressiveness, rated second (strength, rated first). AGG3 = aggressiveness, rated second (anger, rated first).

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

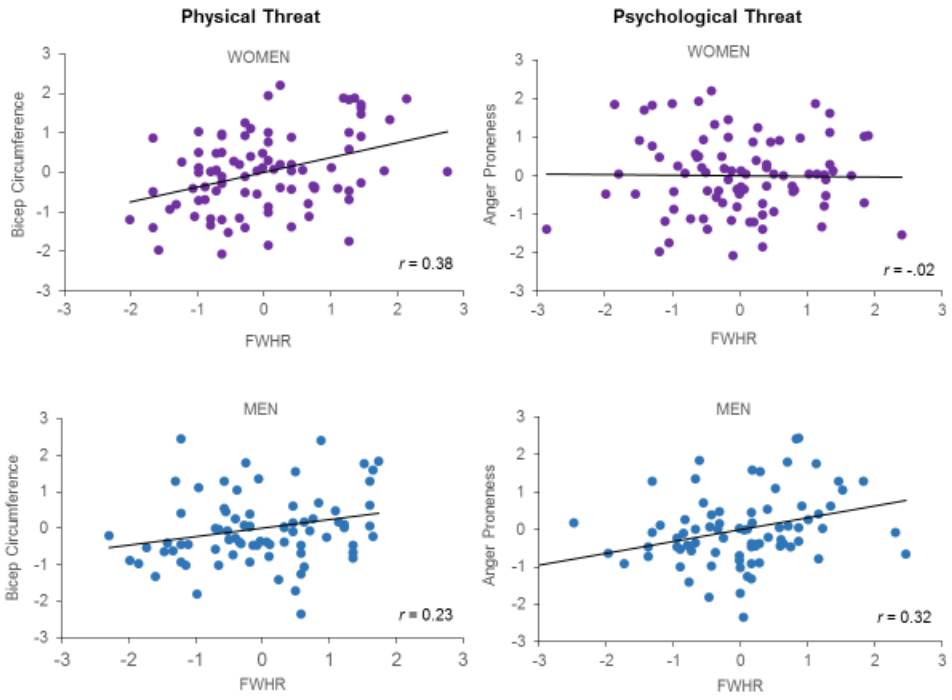

Figure 2. Partial-Correlations (controlling for ethnicity) between measures of threat potential and the FWHR. Each axis depicts standardised values.

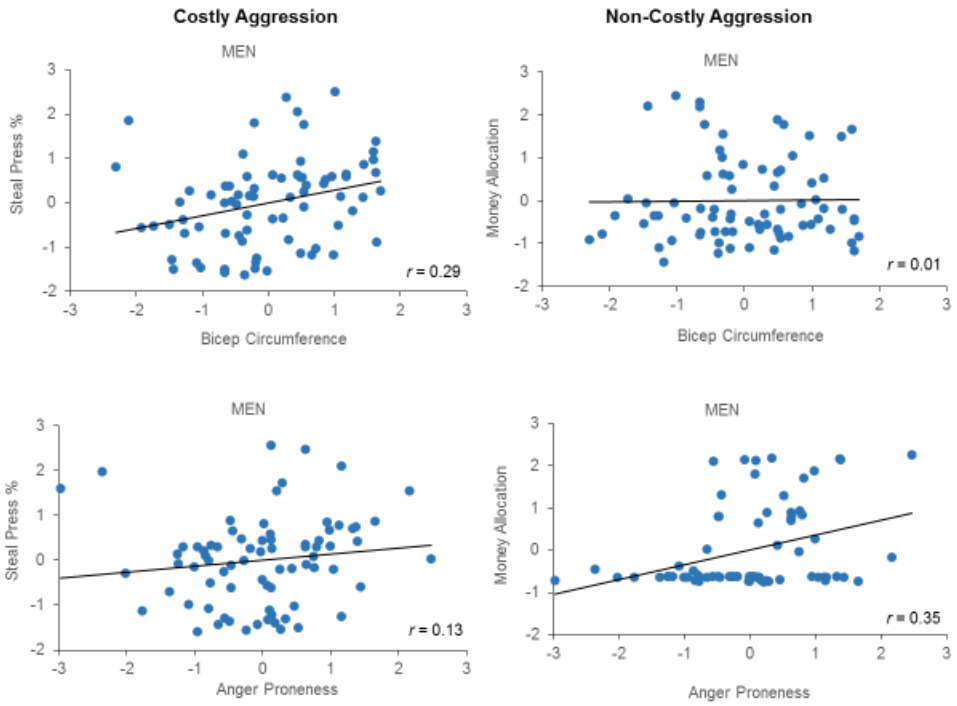

Figure 3. Partial-Correlations, in men, between physical threat potential and both measures of aggression (top). Partial-Correlations, in men, between psychological threat potential and both measures of aggression (bottom).

Discussion

The FWHR is associated with threatening behaviour in men (e.g., Carré & McCormick, 2008), and with judgements of threat (primarily of aggressiveness) in both sexes (e.g., Carré et al., 2009; Carré et al., 2010). These findings were confirmed by a recent meta-analysis (Geniole et al., 2015) and there is evidence that such judgements of threat potential influence observers' behaviour (e.g., Geniole et al., 2016; Haselhuhn et al., 2013; Stirrat & Perrett, 2010; Hehman et al., 2015). Threat potential involves one's ability (i.e., physical threat potential) and propensity (i.e., psychological threat potential) to harm another; which of these aspects of threat potential cued by the FWHR was unknown. The aim of this thesis was to clarify the FWHR's relationship with specific aspects of threat potential, and to investigate whether psychological and physical threat potential differentially predict aggressive behaviour. In addition, this thesis investigated whether observers' judgements of aggressiveness were associated more strongly with physical threat potential or psychological threat potential, and whether observers' judgements of physical threat potential or psychological threat potential were associated with the FWHR.

In study 1, it was found that aspects of an individuals' physical threat potential were associated with their FWHR in both sexes, and an aspect of psychological threat potential was associated with their FWHR in men only. In study 2, both men and women demonstrated some ability to infer the threat potential of others from the face, although this ability was greater for judgements of physical, rather than psychological, threat. Further, the meaning of 'aggressiveness' was also found to differ between the sexes, such that men associated it with physical threat potential, whereas women associated it with psychological threat potential. These findings and their implications will be discussed in the next sections.

Facial Width-to-Height Ratio and Threat Potential

The first aim of Study 1 was to assess how the FWHR relates to physical and psychological indicators of threat potential, as previous research has failed to elucidate which type of threat potential the FWHR and aggression cue. For instance, in Zilioli and colleagues (2015), and Třebický and colleagues (2015) findings of a link between the FWHR and professional fighter success it could not be determined whether the FWHR is cueing physical or psychological threat potential, as the measures of success (e.g., longer careers) could indicate either. In Study 1, the FWHR was positively associated with both physical and psychological indicators of threat in men, and with physical threat potential indicators in women. Specifically, the FWHR was positively correlated with bicep circumference – an index of physical size and strength (Sell et al., 2005; 2009) – in both men and women, and with anger proneness – an index of psychological threat potential – in men only. These findings are supported by previous research demonstrating an association between self-reported anger proneness and upper-body strength in men, but not in women (Sell, 2005; Sell et al., 2009).

Additionally, the finding in men that the FWHR is associated with both types of threat potential provides an explanation for previous research that has found a relationship between the FWHR and threatening behaviour, because the threatening behaviour can be interpreted as reflecting either formidability or anger proneness (but is more likely a reflection of both). This association between physical and psychological threat potential in men would not only explain the aforementioned examples of fighter success (Zilioli et al., 2015; Třebický et al., 2015) but other findings as well. For example, Carré and McCormick (2008) showed that the FWHR is positively associated with a greater number of penalty minutes in two samples of hockey players; these results can be interpreted as evidence that those with higher FWHRs are more likely to express their anger and in turn, are more likely to lash out on the ice. Alternatively, men with

higher FWHRs could be considered more physically strong and consequently more likely to aggress on the ice without the threat of retaliation from other 'weaker' players. This latter explanation is consistent with research demonstrating that physical size is predictive of direct aggression (e.g., Felson, 1996; Campbell, 2006; Archer & Thanzami, 2007). The current findings, however, suggest that both explanations are equally plausible. Another possibility, consistent with results from Study 2, is that the relationship between aggression and either physical or psychological threat potential (or both) is context-dependent. This possibility is discussed further in relation to the results of Study 1b in a later section.

As mentioned, previous research has shown that the association between anger and strength is more pronounced in men than in women (Sell, 2005; Sell et al., 2009). Thus, the current findings linking both types of threat potential to the FWHR was expected to be greater in men than in women. Indeed, in women, the FWHR was associated with aspects of physical threat potential only, as women with larger FWHRs were physically stronger, but not more anger prone. This finding associating aspects of physical threat potential with the FWHR in women is consistent with previous research finding that the FWHR was associated with BMI in women (see Geniole et al., 2015), as BMI is an index of physical threat potential.

Research reviewing the sex differences in aggression concludes that men engage in more costly and direct aggression than do women, but not because of sex differences in anger proneness (Archer, 2004; Campbell, 2006). Instead, these differences have been theorized to be a result of the lack of fear men associate with risky behaviour, compared with that shown by women (Campbell, 2006). Why men show less fear than do woman may involve the sex differences in physical size and strength (men > women), as men have less to fear from aggression due to an increased ability to defend themselves physically (Archer, 2004). For

example, in the current study men had significantly larger biceps than women, and even more pronounced differences in grip strength (men > women). If the hypothesis that differences in fear contribute to sex differences in aggression is true, then a woman who is high in physical threat potential may be more likely to aggress in costly situations and experience more anger, similar to a man, than would a woman lower in physical threat potential. However, in women, physical size is not associated with increased aggression (Gallop, O'Brien, White and Wilson (2010) and this is likely because of the aforementioned differences in physical strength. No matter how strong a woman is relative to other women, her strength is still not comparable (on average) to a man's strength (Lassek & Gaulin, 2009), and thus increases in physical threat potential for women should not coincide with increased aggression or anger proneness. This lack of association between physical threat potential and aggressiveness in women was found in the current study, consistent with previous research (Gallop et al., 2010) and women with larger FWHRs were not more anger prone. Together, these findings suggest that the fear of aggressing may persist in women despite increases in physical threat potential, explaining why research has not found an association between women with large FWHRs and threatening behaviour (reviewed in Geniole et al., 2015).

Nevertheless, individuals, including women (although the effects are less pronounced than in men), with larger FWHRs are rated as more aggressive than are individuals with smaller FWHRs (reviewed in Geniole et al., 2015). According to the overgeneralization of emotional expression hypothesis (Said & Todorov, 2009), judgements derived from static images of a face are done so because of their similarity to emotional expressions (i.e., a resting face that appears to be making an angry expression is evaluated as belonging to an angrier individual). Thus, one explanation for the relationship between the FWHR and perceptions of aggressiveness found in

previous studies (e.g., Carré, et al., 2009; Carré et al., 2010; reviewed in Geniole et al., 2015) is because large FWHRs mimic the expression of anger, which was found to be associated with judgements of aggressiveness in the current study. Despite this interpretation, the observed relationship between the FWHR and self-reported anger proneness in men helps to confirm that men with larger FWHRs are indeed angrier, rather than simply appearing that way.

This observed relationship might indicate that larger FWHRs mimic threatening expressions, such as anger, which in turn leads to greater feelings of anger proneness. In particular, according to the James Lange theory of emotion (Cannon, 1927), one's physical or physiological response informs his/her felt emotions; in the same way, those with larger FWHRs may simulate threatening expressions causing greater feelings of anger or threat. For example, research has shown that when individuals are asked to appear more threatening, they inadvertently increase the size of their FWHRs by tilting their heads downward or upward (Hehman, Leitner, & Gaertner, 2013). Thus, the observed relationship between the FWHR and anger proneness in the current study may be a result of this attribution process and the known association between bodily cues and emotions (e.g., a smile is typically reflective of happiness).

In contrast, the current findings could be interpreted as indicating that physical features related to threat have been selected to confer an evolutionary advantage in terms of cueing threat among conspecifics. For example, the expression of fear may have derived from the relationship between the FWHR and anger proneness. If the FWHR is a cue of psychological threat potential (which the current findings support, in men), then the expression of fear could have developed to alleviate this association by changing one's expression so others deem them less threatening. Supporting this explanation, Marsh, Adams, & Kleck (2005) demonstrated that expressions of anger are associated with more mature faces and expressions of fear are associated with less

mature, babyish faces. Additionally, Sell, Cosmides, and Tooby (2014) demonstrated that each feature of the angry face is related to perceptions of strength. Together, these studies suggest that there is a relationship between the expression of anger and one's FWHR because the FWHR evolved to signal one's threat potential to others. Future research is required to investigate the specific qualities that angry faces were designed to convey (e.g., damage resistance), to enhance the validity of this explanation.

In initial investigations, the FWHR was found to be sexual dimorphic (see Weston et al., 2007), although some studies found no sex difference (e.g., Lefevre et al., 2012; Özener, 2012). The current findings support more recent research, as men were found to have marginally larger FWHRs than women; the effect size associated with this finding is comparable to that of the meta-analysis by Geniole and colleagues (2015). However, in the current study, the relationship between sex and the FWHR was found to vary as a function of ethnicity, whereby non-white men had larger FWHRs than white men and white women had larger FWHRs than non-white women. Presently, research examining FWHR variability among ethnic groups is lacking. Irrespective of the extent to which there is a robust sex difference in the size of the FWHR, the within-sex variation in the FWHR is predictive of behaviour (reviewed in Geniole et al., 2015). Further, the within-sex variation in the FWHR may be more relevant to social interactions than the variation between the sexes, as has been argued for the study of individual differences from an evolutionary perspective (e.g., Buss, 2009).

Physical and Psychological Threat Potential as Predictors of Aggression

Study 1b investigated the extent to which aspects of physical and psychological threat potential predicted distinct types of aggressive responding. Specifically, we examined reactive aggression that does, and does not, come at a tangible cost using two measures: the PSAP (costly reactive

aggression) and a money allocation task (non-costly reactive aggression). Previous research has shown that physical and threat potential are predictive of aggression, but that physical threat potential may better predict costly aggression (Archer & Thanzami, 2007). Indeed, results showed that in men, physical threat potential (measured by bicep circumference) predicted costly reactive aggression and psychological threat potential (measured by anger proneness) was found to predict non-costly reactive aggression. In contrast, when examined in women, no relationships were observed. This finding in women is consistent with previous research showing that women are less likely to directly challenge a provoker and to engage in direct aggression than are men (reviewed in Campbell, 2006).

As discussed previously, Archer (2004) suggests that the physically strong aggress more than the physically weak because the physical costs (e.g., bodily harm, physical injury) associated with aggression are not as great for them. This hypothesis helps explain the sex differences in direct aggression (Archer 2004; Campbell, 2006). The current findings demonstrate that physically stronger men aggress more regardless of the nature of costs (e.g., even when the costs are monetary, not physical). Thus, the hypothesised lack of fear in men who are high in physical threat potential is seemingly carrying over to aggression decisions that should not be taking one's own physical threat potential into account. Future research should examine the consistency of this finding, while extending it to other types of costs associated with aggression, e.g., threats to social status.

In men, the same participants (those high in physical threat potential) who aggressed more during the costly aggression task did not aggress more on the non-costly measure of aggression. Why higher physical threat potential in men was associated only with costly aggression is unknown. One possibility is the nature of the aggression measures over and above

the extent to which the aggression is costly. The PSAP has been viewed as a form of competition (see Geniole et al., 2016). Perhaps men higher in physical threat potential are likely to punish another in the context of direct competition because they view their punishing act as being more salient; part of the satisfaction these individuals gain from punishment may come from the immediate thrill of disrupting their competitor. We previously found that greater aggressive behaviour in the PSAP was associated with greater enjoyment of the PSAP (Geniole, Carré, and McCormick, 2011). It may be that retaliation in the PSAP diminished the need for retaliation in the money allocation task.

An alternative view is that the participants who stole more from their opponent felt that the provocation that came before the money allocation task was not as provoking as did participants who stole less. The participants who stole less during the PSAP may have felt 'robbed' by their opponent after being told that they would not receive a monetary amount because of their opponent's actions. Thus, within these participants, those with lower anger thresholds were triggered by the frustration of playing 'fair', but losing anyway. Regardless of these alternative explanations, the current findings support previous research that physical size is predictive of costly aggression in men (Archer & Thanzami, 2007). Further, they demonstrate that psychological threat potential is an important predictor of threat potential in certain contexts, regardless of one's own physical threat potential.

In women, physical threat potential did not predict aggression in either task. These results suggest that physical threat potential is not a sufficient predictor of aggressive behaviour in women, supported by previous research demonstrating no relationship between a women's strength and aggression (see Gallop et al., 2010). Additionally, and in contrast to men, psychological threat potential was not significantly associated with non-costly aggression in

women (although the result was in the same direction as that for men). These results could be explained by sex differences in anger proneness, but men and women did not differ in anger proneness in our sample and previous research also reported no sex difference in anger proneness (see Archer 2004; Campbell, 2006). Given that previous research has shown that women attribute greater costs with aggressing than do men do (e.g., Archer, Fernández-Fuertes, & Thanzami, 2010; Rutter & Hine, 2005), the likely explanation is that even on a measure designed to eliminate the costs associated with an aggressive response, women have a predisposition to infer costs. Thus, psychological threat potential, specifically anger proneness, may not be a useful predictor of aggression in women, even in situations were the cost of aggressing is miniscule to non-existent.

Facial Width-to-Height Ratio and Observer Judgements of Threat

Study 2 investigated whether observers' judgements of physical and psychological threat potential were associated with the FWHR in faces of men from Study 1, and the extent to which these judgements are accurate, as determined by their association with the measures of physical and psychological threat potential obtained from the same men in Study 1.

Previous research has shown a consistent association between observers' judgements of aggressiveness and the FWHRs of the observed (e.g., Carré et al., 2009; Carré et al., 2010; reviewed in Geniole et al., 2015). The current findings are consistent with previous research, as the FWHR was positively associated with observers' judgements of aggressiveness. However, the FWHR was not associated with judgements of anger proneness in either male and female observers, despite the conceptual similarities between anger and aggressiveness. This lack of association between the FWHR and ratings of anger proneness in the current study could be reflective of the nature of the rating task; that is, asking participants (especially university

students) to rate someone's aggressiveness might be an attribution that they are more familiar with, as opposed to rating someone's anger proneness. Nevertheless, the relationship between the FWHR and judgements of anger was in the expected direction, and judgements of anger were modestly associated with judgements of aggression, for both sexes.

In men only, the FWHR was also associated with judgements of strength, such that individuals with larger FWHRs were rated as physically stronger than were individuals with smaller FWHRs. This result is likely because of the association among ratings. Women's ratings of aggressiveness were highly associated with their ratings of anger proneness, whereas men's ratings of aggressiveness were highly associated with their ratings of strength. These findings suggest that the meaning of 'aggressiveness' (which previous research has consistently used to infer threat potential, e.g., Carré et al., 2009; Carré et al., 2010; reviewed in Geniole et al., 2015), may be different for men and women. To elaborate, in men, aggressiveness is thought to indicate physical threat (i.e., an individual who appears to be strong will be rated as more aggressive) whereas in women, aggressiveness is related to psychological threat (i.e., an individual who appears to be anger prone is rated as more aggressive). The question of why these sex differences exist remains. However, evolutionary psychologists have theorized that differences in psychology between men and women are influenced by the social roles that each sex has typically adopted (Eagly & Wood, 1999). Thus, it is likely that the findings that men associate aggressiveness with strength more so than anger, and women associate aggressiveness with anger more so than strength, are a by-product of the primary concerns of each sex in ancestral environments. That is to say, the adaptive benefits of associating strength with aggressiveness are greater for men than for women because men have historically engaged in more direct conflict than women (Walker, 2001).

Accuracy of Observers' Judgements

The current results show that women observers' judgements of strength were positively associated with the bicep circumference, the index of strength, of the stimulus faces. However, no association was found between men observers' judgements of strength and the faces' bicep circumference. These results show that women, but not men, can accurately infer the strength of another from the face alone. These results are inconsistent with previous research showing that both men and women can accurately assess physical strength from the face (Sell, 2008). This discrepancy may be due in part to the index of physical threat potential – bicep circumference – used in the sample. While bicep circumference was shown previously to share the strongest correlation with actual upper-body strength (Sell, 2005), this result was obtained in a sample of individuals who regularly exercise and lift weights. Given that body fat adds weight to the size of the arm without increasing strength, the association between bicep circumference and strength is likely not as pronounced in the current sample as it was in the one by Sell (2005). Nevertheless, men observers' judgements of anger proneness were positively correlated with bicep circumference of the stimulus faces. This result indicates that men view other men higher in physical threat potential as also being higher in psychological threat potential, consistent with the found association between ratings of aggressiveness and strength in men.

Neither women nor men were accurate in assessing the self-reported anger proneness of the participants from study 1, although all correlations where in the expected direction and most approached significance. Additionally, men observers' ratings of aggressiveness and of strength were associated with the self-reported anger proneness scores of the stimulus faces. These findings show that both sexes demonstrate only a modest ability to infer how anger prone another is from the face.

Study 2 also examined how judgements of strength, of anger proneness, and of aggressiveness are associated with the aggressive behaviour of participants from study 1. In men, judgements of aggressiveness and of strength were positively associated with the costly aggression scores of participants from study 1, but no associations were found with the non-costly aggression scores of participants from study 1. In women, observers' ratings of anger proneness, but not of aggressiveness or of strength, were associated with costly aggression. This ability may have derived from an adaption to associate one type of threat potential with another, as doing so would increase the survivability of the individual making the judgement (i.e., better safe than sorry).

Taken together, the findings from study 2 are mostly consistent with previous research (Sell, 2008; Sell et al., 2009) and imply that humans have an adaptive ability to infer both psychological and physical threat potential from the face. Moreover, these findings suggest that others' judgements of aggressiveness may derive from these strength and anger judgements, such that women associate aggressiveness with anger and men associate aggressiveness with physical strength.

Relationship between physical and psychological threat potential

According to Sell and colleagues (2005, 2009a, 2009b), anger and physical strength are inherently linked in men as predicted by the recalibration theory of anger (RTA). The RTA asserts that anger evolved as a means of readjusting or 'recalibrating' other's perceptions of the angry individual to be more appropriate or in line with how the angry individual feels they should be valued (Sell, 2011). For instance, in a bargaining situation an individual may become angry after an unfair monetary offer, this may in turn cause the proposer to readjust their perceptions of the angry individual and offer a greater amount. In Sell's work (2009) in

particular, he proposes that stronger men have lower anger thresholds than weaker men because they have an increased ability to cause harm. This, in turn, causes stronger men to expect better treatment from others (i.e., they possess a greater sense of entitlement) and as a result, little provocation is required for them to feel as though they were mistreated. In contrast to this, the current study found no direct association between anger proneness and bicep size, nor was anger proneness related to other measures of physical threat potential (grip strength or self-reported strength). This finding, however, is not inconsistent with other research that has attempted to replicate Sells and colleagues work. Indeed, Archer and Thanzami (2007) administered the well validated Buss-Perry Aggression Questionnaire (BPAQ) to a sample of young men and found that scores on the anger subscale were not associated with the height, weight, grip strength for both hands, and bicep circumference of the participants.

While the RTA remains plausible, the assertion that stronger men have a lower threshold for anger because of greater expectations of fair treatment or greater entitlement is not supported by the results of this thesis. Sell and colleagues (2009) imply a mediation model in men to explain why anger and strength are linked, such that the effect of strength on anger is mediated by a sense of entitlement. Similarly, Archer and Thanzami, 2009 showed that entitlement is predictive of aggressive behaviour; however, no relationship between strength and entitlement was observed, consistent with the current results. The relationship between strength and entitlement in men is likely influenced by other variables (e.g., attractiveness, confidence), which in turn impacts aggression. This might account for inconsistent findings in the literature and further examination of these extraneous variables may provide a more comprehensive explanation of the lack of association between strength and entitlement. Nevertheless, much research is needed to determine the precise nature of the relationship between physical threat

potential, entitlement, and anger proneness in men.

Conclusion

This thesis was the first to investigate the specific aspects of threat potential that are associated with the FWHR, and how both types of threat potential predict different types of aggression. Our lab has previously proposed an Advertisement, Assessment, and Action (AAA) model (Figure 4) to explain the relationship between what the FWHR cues, and how others interpretation of these cues informs their actions (Geniole, 2016). The first part of the model (advertisement) shows that components of the face (in this case, the FWHR) are reflective of an individual's threat potential, because the shape of the face is a result of biological and developmental factors that have simultaneously shaped their neural circuitry and physical strength. These factors in turn affect an individual's personality and social behaviour, which work in conjunction with physical strength and size to predict an individual's threat potential. The second pat of the model (assessment) shows that during first encounters with another, the face is used to infer threat potential. This inference is accurate to the extent the FWHR is correlated with the threat potential of another, and individual differences in perception. The third part of the model (action) suggest that others use the inference of threat potential to inform their behaviour (e.g., approach or avoid). This thesis has updated the model to include the sex-specific aspects of threat potential that the FWHR cues, and how men and women differentially infer either psychological or physical threat potential when assessing the 'aggressiveness' of another (Figure 5).

The results from this thesis showed no association between psychological and physical threat potential. This finding is inconsistent with previous research which has argued for a positive association between both types of threat potential in men (Sell et al., 2009). Supporting

the current findings of no association between both types of threat potential, it was shown that, in men, aspects of physical and psychological threat potential differentially predict aggressive behaviour. This finding demonstrates that aggression decisions are context-specific and are predicted by different aspects of threat potential. As the current findings have been supported by previous research which has found no relationship between aspects of psychological and physical threat potential in men (Archer & Thanzami, 2007), the current view that they are associated needs to be revaluated as ancestral explanations for their associations may be trumped by factors that are present in modern social environments.

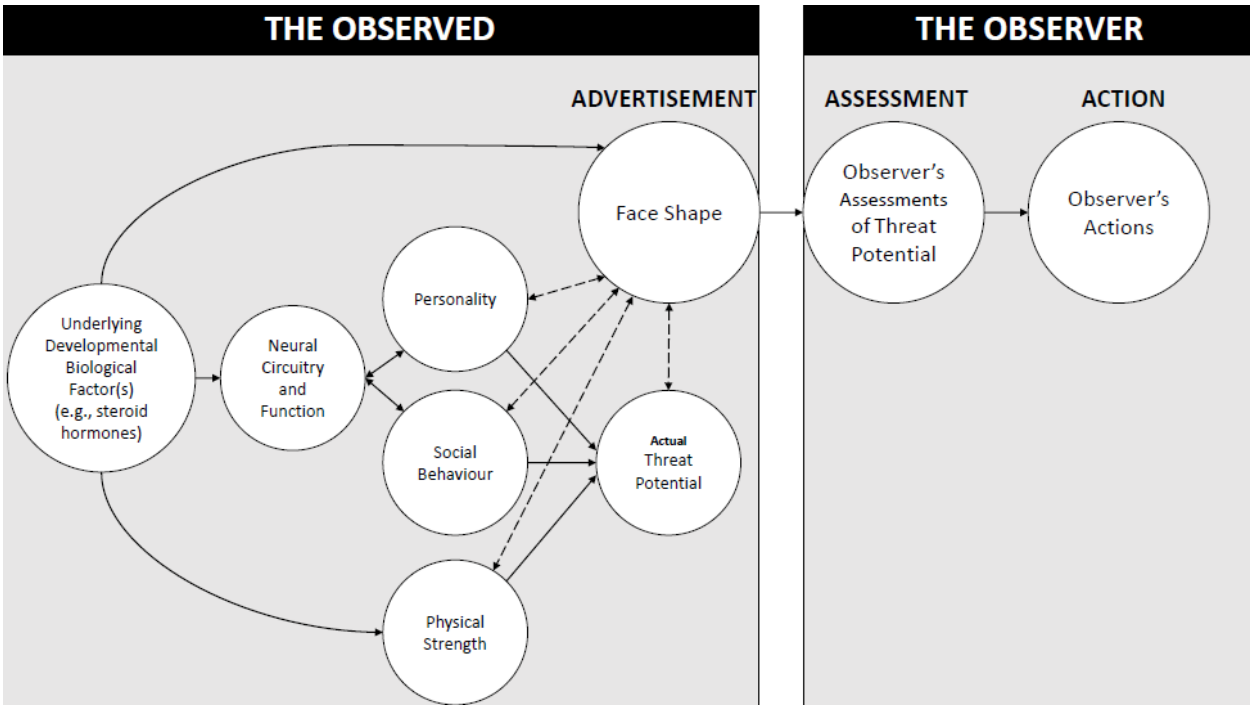

Figure 4. A graphical representation of the Advertisement, Assessment, and Action (AAA) model, proposed in Geniole, 2016. Solid lines represent causal relationships, and dashed lines represent non-causal relationships.

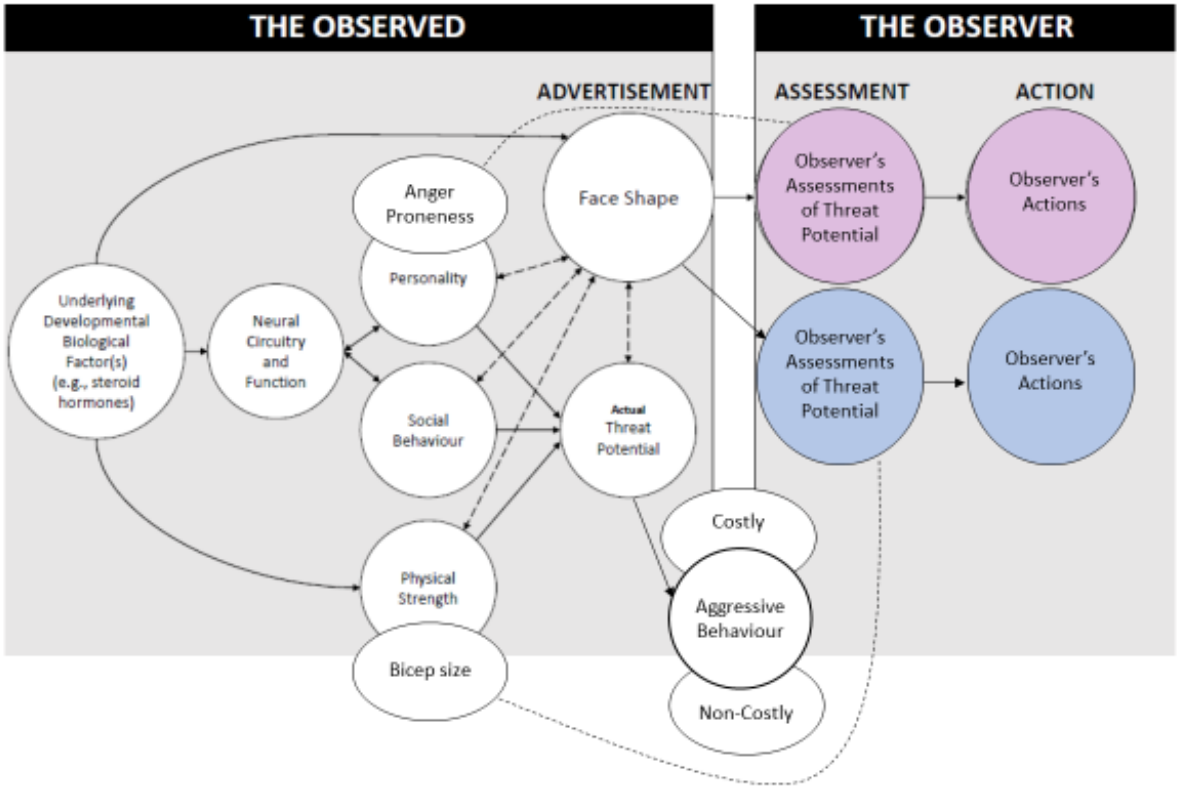

Figure 5. An updated graphical representation of the Advertisement, Assessment, and Action (AAA) model, proposed in Geniole, 2016. Female observers are in purple (top), male observers are in blue (bottom). Solid lines represent causal relationships, and dashed lines represent non-causal relationships.

References

Allen, T. J., Dougherty, D. M., Rhoades, H. M., & Cherek, D. R. (1996). A study of male and female aggressive responding under conditions providing an escape response. *The Psychological Record*, *46*(4), 651.

Archer, J. (2004). Sex Differences in Aggression in Real-World Settings: A Meta-Analytic Review. *Review of general Psychology*, *8*(4), 291–322. http://doi.org/10.1037/1089-2680.8.4.291

Archer, J. (2006). Testosterone and human aggression: an evaluation of the challenge hypothesis. *Neuroscience & Biobehavioral Reviews*, *30*(3), 319-345.

Archer, J., & Thanzami, V. (2007). The relation between physical aggression, size and strength, among a sample of young Indian men. *Personality and Individual Differences*, *43*, 627–633. http://doi.org/10.1016/j.paid.2007.01.005

Archer, J., & Thanzami, V. (2009). The relation between mate value, entitlement, physical aggression, size and strength among a sample of young Indian men. *Evolution and Human Behavior*, *30*(5), 315-321.

Bailly, M. D., & King, A. R. (2006). Trait modulation of alcohol-induced laboratory aggression. *Psychiatry Research*, *142*(2), 129–138.

Bar, M., Neta, M., & Linz, H. (2006). Very first impressions. *Emotion*, *6*(2), 269–278. http://doi.org/10.1037/1528-3542.6.2.269

Baron, R. A., & Richardson, D. R. (1994). Human Aggression, 2 ed. New York: Plenum Press.

Berglund, A., & Rosenqvist, G. (2009). An intimidating ornament in a female pipefish. *Behavioral Ecology*, *20*(1), 54–59. http://doi.org/10.1093/beheco/arn114

Berry, D. S. (1990). Taking people at face value: Evidence for the kernel of truth hypothesis. *Social Cognition*, *8*(4), 343–361.

Berry, D. S. (1991). Accuracy in Social Perception: Contributions of Facial and Vocal Information. *Journal of personality and social psychology*, *61*(2), 298–307.

Blanchard, D. C., Griebel, G., Pobbe, R., & Blanchard, R. J. (2011). Risk assessment as an evolved threat detection and analysis process. *Neuroscience and Biobehavioral Reviews*, *35*(4), 991–998. http://doi.org/10.1016/j.neubiorev.2010.10.016

Borgi, M., & Majolo, B. (2016). Facial width-to-height ratio relates to dominance style in the genus Macaca. *PeerJ*, *4*, e1775.

Callander, S., Kahn, A. T., Maricic, T., Jennions, M. D., & Backwell, P. R. Y. (2013). Weapons or mating signals? Claw shape and mate choice in a fiddler crab. *Behavioral Ecology and Sociobiology*, *67*(7), 1163–1167. http://doi.org/10.1007/s00265-013-1541-6

Campbell, A. (2006). Sex differences in direct aggression: What are the psychological mediators? *Aggression and Violent Behavior*, *11*(3), 237–264.

Cannon, W. B. (1927). The James-Lange theory of emotions: A critical examination and an alternative theory. *The American Journal of Psychology*, *39*(1/4), 106-124.

Carré, J. M., & McCormick, C. M. (2008). In your face: facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players. *Proceedings of the Royal Society B: Biological Sciences*, *275*(1651), 2651–2656. http://doi.org/10.1098/rspb.2008.0873

Carré, J. M., McCormick, C. M., & Mondloch, C. J. (2009). Facial structure is a reliable cue of aggressive behavior. *Psychological Science*, *20*(10), 1194-1198.

Carré, J. M., Morrissey, M. D., Mondloch, C. J., & McCormick, C. M. (2010). Estimating aggression from emotionally neutral faces: which facial cues are diagnostic?. *Perception, 39*(3), 356-377.

Carré, J. M., & Archer, J. (2017). Testosterone and Human Behavior: The role of individual and contextual variables. *Current Opinion in Psychology*, 19, 149-153.

Choi, J.-K., & Bowles, S. (2007). The Coevolution of Parochial Altruism and War. *Science, 318*(5850), 636–640. http://doi.org/10.1126/science.1144237

Christiansen, K., & Winkler, E. (1992). Hormonal , Anthropometrical , and Behavioral Correlates of Physical Aggression in ! Kung San Men of Namibia. *Aggressive Behavior, 18*, 271–280. http://doi.org/10.1002/1098-2337(1992)18:4<271::AID-AB2480180403>3.0.CO;2-6

Coetzee, V., Chen, J., Perrett, D. I., & Stephen, I. D. (2010). Deciphering faces: Quantifiable visual cues to weight. *Perception*, *39*(1), 51–61. http://doi.org/10.1068/p6560

Deaner, R. O., Goetz, S. M. M., Shattuck, K., & Schnotala, T. (2012). Body weight, not facial width-to-height ratio, predicts aggression in pro hockey players. *Journal of Research in Personality*, *46*(2), 235–238. http://doi.org/10.1016/j.jrp.2012.01.005

Deffenbacher, J. L., Deffenbacher, D. M., Lynch, R. S., & Richards, T. L. (2003). Anger, aggression, and risky behavior: a comparison of high and low anger drivers. *Behaviour Research and Therapy*, *41*(6), 701–718.

Eagly, A. H., & Wood, W. (1999). The origins of sex differences in human behavior: Evolved dispositions versus social roles. *American Psychologist*, *54*(6), 408.

Ekman, P., Friesen, W. V, Sullivan, M. O., Chan, A., Heider, K., Lecompte, W. A., … Scherer, K. (1987). Universals and Cultural Differences in the Judgments of Facial Expressions of

Emotion. *Journal of Personality and Social Psychology*, 53(4), 712–717. http://doi.org/10.1037/0022-3514.53.4.712

Felson, R. B. (1996). Big people hit little people: Sex differences in physical power and interpersonal violence. *Criminology*, *34*(3), 433–452.

Geniole, S. N., Denson, T. F., Dixson, B. J., Carré, J. M., & McCormick, C. M. (2015). Evidence from meta-analyses of the facial width-to-height ratio as an evolved cue of threat. *PLoS ONE*, *10*(7), 1–18. http://doi.org/10.1371/journal.pone.0132726

Geniole, S. N., Busseri, M. A., & McCormick, C. M. (2013). Testosterone dynamics and psychopathic personality traits independently predict antagonistic behavior towards the perceived loser of a competitive interaction. *Hormones and Behavior*, *64*(5), 790–798.

Geniole, S. N., Carré, J. M., & McCormick, C. M. (2011). State, not trait, neuroendocrine function predicts costly reactive aggression in men after social exclusion and inclusion. *Biological Psychology*, *87*(1), 137–145.

Geniole, S. N., MacDonell, E. T., & McCormick, C. M. (2016). The Point Subtraction Aggression Paradigm as a laboratory tool for investigating the neuroendocrinology of aggression and competition. *Hormones and Behavior*. *92,* 103-116. http://doi.org/10.1016/j.yhbeh.2016.04.006

Geniole, S. (2016). The Facial Width-to-Height Ratio and its Role in Advertisements and Assessments of Threat Potential (unpublished doctoral thesis). Department of Psychology, Brock University, Canada.

Golomb, B. A., Cortez-Perez, M., Jaworski, B. A., Mednick, S., & Dimsdale, J. (2007). Point Subtraction Aggression Paradigm: validity of a brief schedule of use. *Violence and Victims*, *22*(1), 95–103.

Haselhuhn, M. P., & Wong, E. M. (2012). Bad to the bone: facial structure predicts unethical behaviour. *Proceedings. Biological Sciences / The Royal Society*, *279*(1728), 571–576. http://doi.org/10.1098/rspb.2011.1193

Haselhuhn, M. P., Wong, E. M., & Ormiston, M. E. (2013). Self-Fulfilling Prophecies as a Link between Men' s Facial Width-to-Height Ratio and Behavior. *PloS one*, *8*(8). http://doi.org/10.1371/journal.pone.0072259

Haselhuhn, M. P., Ormiston, M. E., & Wong, E. M. (2015). Men's facial width-to-height ratio predicts aggression: A meta-analysis. *PLoS ONE*, *10*(4), 1–10. http://doi.org/10.1371/journal.pone.0122637

Haxby, J. V, Hoffman, E. A., & Gobbini, M. I. (2000). The distributed human neural system for face perception. *Trends in Cognitive Sciences*, *4*(6), 223–233.

Hehman, E., Leitner, J. B., & Gaertner, S. L. (2013). Enhancing static facial features increases intimidation. *Journal of Experimental Social Psychology*, *49*(4), 747–754. http://doi.org/10.1016/j.jesp.2013.02.015

Hehman, E., Leitner, J. B., & Freeman, J. B. (2014). The Face – Time Continuum: Lifespan Changes in Facial Width-to-Height Ratio Impact Aging-Associated Perceptions. *Personality and Social Psychology Bulletin*, *40*(12), 1624-1636. http://doi.org/10.1177/0146167214552791

Hehman, E., Leitner, J. B., Deegan, M. P., & Gaertner, S. L. (2015). Picking teams : When dominant facial structure is preferred. *Journal of Experimental Social Psychology*, *59*, 51–59. http://doi.org/10.1016/j.jesp.2015.03.007

Järvi, T., & Bakken, M. (1984). The function of the variation in the breast stripe of the great tit (Parus major). *Animal Behaviour*, *32*(2), 590–596. http://doi.org/10.1016/S0003-3472(84)80296-1

Lefevre, C. E., Lewis, G. J., Bates, T. C., Dzhelyova, M., Coetzee, V., Deary, I. J., & Perrett, D. I. (2012). No evidence for sexual dimorphism of facial width-to-height ratio in four large adult samples. *Evolution and Human Behavior*, *33*(6), 623-627.

Lefevre, C. E., Etchells, P. J., Howell, E. C., Clark, A. P., & Penton-Voak, I. S. (2014). Facial width-to-height ratio predicts self-reported dominance and aggression in males and females, but a measure of masculinity does not. *Biology Letters*, *10*(1), 20140729–20140729. http://doi.org/10.1098/rsbl.2014.0729

Lefevre, C. E., Wilson, V. A. D., Morton, F. B., Brosnan, S. F., Paukner, A., & Bates, T. C. (2014). Facial width-to-height ratio relates to alpha status and assertive personality in capuchin monkeys. *PLoS ONE*, *9*(4), 1–8. http://doi.org/10.1371/journal.pone.0093369

Marsh, A. Adams., Jr, R. B., & Kleck, R. E. (2005). Why Do Fear and Anger Look the Way They Do ? Form and Social Function in Facial Expressions. P*ersonality and Social Psychology Bulletin*, *31*(1), 73-86. http://doi.org/10.1177/0146167204271306

Maynard-Smith, J., & Harper, D. (2003). *Animal Signals*. *Animal signals*. Oxford University Press. http://doi.org/ISBN-10: 0198526857\rISBN-13: 978-0198526858

McGregor, H. A., Lieberman, J. D., Greenberg, J., Solomon, S., Arndt, J., Simon, L., & Pyszczynski, T. (1998). Terror management and aggression: evidence that mortality salience motivates aggression against worldview-threatening others. *Journal of Personality and Social Psychology*, *74*(3), 590.

Mileva, V. R., Cowan, M. L., Cobey, K. D., Knowles, K. K., & Little, A. C. (2014). In the face of dominance: Self-perceived and other-perceived dominance are positively associated with facial-width-to-height ratio in men. *Personality and Individual Differences*, *69*, 115–118. http://doi.org/10.1016/j.paid.2014.05.019

Montepare, J. M., & Zebrowitz, L. A. (1998). Person perception comes of age: The salience and significance of age in social judgments. *Advances in Experimental Social Psychology*, *30*, 93–161.

Özener, B. (2012). Facial width-to-height ratio in a Turkish population is not sexually dimorphic and is unrelated to aggressive behavior. *Evolution and Human Behavior*, *33*(3), 169–173. http://doi.org/10.1016/j.evolhumbehav.2011.08.001

Parker, G. A. (1974). Assessment strategy and the evolution of fighting behaviour. *Journal of Theoretical Biology*, *47*(1), 223–243.

Parrett, M. (2015). Beauty and the feast: Examining the effect of beauty on earnings using restaurant tipping data. *Journal of Economic Psychology*, *49*, 34–46.

Reidy, D. E., Zeichner, A., Foster, J. D., & Martinez, M. A. (2008). Effects of narcissistic entitlement and exploitativeness on human physical aggression. *Personality and Individual Differences*, *44*(4), 865–875.

Said, C. P., & Todorov, A. (2009). Structural Resemblance to Emotional Expressions Predicts Evaluation of Emotionally Neutral Faces. *Emotion*, *9*(2), 260–264. http://doi.org/10.1037/a0014681

Sell, A. (2005). Regulating welfare tradeoff ratios: three tests of an evolutionary-computational model of human anger (unpublished doctoral thesis, Psychology). Department of Psychological and Brain Sciences, University of California Santa Barbara.

Sell, A., Cosmides, L., Tooby, J., Sznycer, D., Rueden, C. Von, & Gurven, M. (2009). Human adaptations for the visual assessment of strength and fighting ability from the body and face. *Proceedings of the Royal Society of London B: Biological Sciences*, *276*(1656), 575-584. http://doi.org/10.1098/rspb.2008.1177

Sell, A., Tooby, J., & Cosmides, L. (2009). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(35), 15073–15078. http://doi.org/10.1073/pnas.0904312106

Sell, A. N. (2011). Aggression and Violent Behavior The recalibrational theory and violent anger. *Aggression and Violent Behavior*, *16*(5), 381–389. http://doi.org/10.1016/j.avb.2011.04.013

Sell, A., Cosmides, L., & Tooby, J. (2014). Evolution and Human Behavior The human anger face evolved to enhance cues of strength. *Evolution and Human Behavior*, *35*(5), 425–429. http://doi.org/10.1016/j.evolhumbehav.2014.05.008

Short, L. A., Mondloch, C. J., McCormick, C. M., Carré, J. M., Ma, R., Fu, G., & Lee, K. (2012). Detection of propensity for aggression based on facial structure irrespective of face race. *Evolution and Human Behavior*, *33*(2), 121–129.

Stillman, T. F., Maner, J. K., & Baumeister, R. F. (2010). A thin slice of violence : distinguishing violent from nonviolent sex offenders at a glance. *Evolution and Human Behavior*, *31*(4), 298–303. http://doi.org/10.1016/j.evolhumbehav.2009.12.001

Stirrat, M., & Perrett, D. I. (2010). Valid facial cues to cooperation and trust: male facial width and trustworthiness. *Psychological Science*, *21*(3), 349–354. http://doi.org/10.1177/0956797610362647

Stirrat, M., Stulp, G., & Pollet, T. V. (2012). Male facial width is associated with death by contact violence: Narrow-faced males are more likely to die from contact violence. *Evolution and Human Behavior, 33*(5), 551–556. http://doi.org/10.1016/j.evolhumbehav.2012.02.002

Tibbetts, E. A., & Lindsay, R. (2008). Visual signals of status and rival assessment in Polistes dominulus paper wasps. *Biology Letters*, *4*(3), 237–239. http://doi.org/10.1098/rsbl.2008.0048

Tibbetts, E. a, & Dale, J. (2004). A socially enforced signal of quality in a paper wasp. *Nature*, *432*(7014), 218–222. http://doi.org/10.1038/nature02949

Todorov, A., Mandisodza, A. N., Goren, A., & Hall, C. C. (2005). Inferences of competence from faces predict election outcomes. *Science*, *308*(5728), 1623–1626.

Třebický, V., Fialová, J., Kleisner, K., Roberts, S. C., Little, A. C., & Havlíček, J. (2015). Further evidence for links between facial width-to-height ratio and fighting success: Commentary on Zilioli et al. (2014). *Aggressive Behavior*, *41*(4), 331–334. http://doi.org/10.1002/ab.21559

Valentine, K. A., Li, N. P., Penke, L., & Perrett, D. I. (2014). Judging a man by the width of his face the role of facial ratios and dominance in mate choice at speed-dating events. *Psychological Science*, *25*(3), 806-811.

Wagner, W. E. (1989). Graded aggressive signals in Blanchard's cricket frog: vocal responses to opponent proximity and size. *Animal Behaviour*, *38*(6), 1025–1038. http://doi.org/10.1016/S0003-3472(89)80141-1

Walker, P. L. (2001). A bioarchaeological perspective on the history of violence. *Annual Review of Anthropology*, *30*(1), 573-596.

Weston, E. M., Friday, A. E., & Liò, P. (2007). Biometric evidence that sexual selection has shaped the hominin face. *PLoS ONE*, *2*(8). http://doi.org/10.1371/journal.pone.0000710

Willis, J., & Todorov, A. T. (2013). Making up your mind after 100-ms exposure to face. *Psychological Science*, *17*(7), 592–598.

Wilson, M., & Daly, M. (1985). Competitiveness, risk taking, and violence: The young male syndrome. *Ethology and Sociobiology*, *6*(1), 59–73.

Wilson, J. P., Hugenberg, K., & Rule, N. O. (2017). Racial Bias in Judgments of Physical Size and Formidability: From Size to Threat. *Journal of Personality and Social Psychology*. Online First Publication, March 13, 2017. http://dx.doi.org/10.1037/pspi0000092

Zebrowitz, L. A., & Montepare, J. M. (2008). Social Psychological Face Perception: Why Appearance Matters. *Social and personality psychology compass*, *2*(3), 1497-1517.

Zilioli, S., Sell, A. N., Stirrat, M., Jagore, J., Vickerman, W., & Watson, N. V. (2015). Face of a fighter: Bizygomatic width as a cue of formidability. *Aggressive Behavior*, *41*, 322–330. http://doi.org/10.1002/ab.21544

Appendix A. Brock University Research Ethics Board Clearance

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Social Science Research Ethics Board

Certificate of Ethics Clearance for Human Participant Research

DATE: 10/14/2016

PRINCIPAL INVESTIGATOR: McCORMICK, Cheryl - Psychology

FILE: 14-061 - McCORMICK

TYPE: Ph. D. STUDENT: Elliott MacDonell
SUPERVISOR: Cheryl McCormick

TITLE: Investigating links between snap judgements and personality, facial structure, beliefs about conflict politics, strength, and political and sexual orientation

ETHICS CLEARANCE GRANTED

Type of Clearance: RENEWAL

Initial Clearance Date: 10/30/2014
Expiry Date: 10/31/2017

The Brock University Social Science Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement.

Renewed certificate valid from **10/14/2016 to 10/31/2017**.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before **10/31/2017**. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms.

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved: J. Frijters

Jan Frijters, Chair
Social Science Research Ethics Board

Note: Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix B. Study 1 Consent Form

Date: January 1st, 2014
Project Title: Exploring the relationship between hormones, strength, beliefs about conflict, facial structure, and strategic decision-making.

Principal Investigator

Cheryl McCormick, PhD
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Principal Student Investigator

Shawn Geniole
MA Student
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Shawn.geniole@brocku.ca

INVITATION

You are invited to participate in a study that involves 1 hour research participation credit and the potential to be awarded an amount of money based on gameplay (up to $5). You will also be entered into a draw for $100 cash prize. The purpose of this study is to investigate the influence of salivary hormones, beliefs about conflict, strength, and facial structure on strategic decision making in a computer game.

WHAT'S INVOLVED

As a participant, you will be asked to provide the researcher with two saliva samples (1 – 2 mL) to later be assessed for testosterone, cortisol, and estradiol. This involves spitting into a vial. This is the least intrusive method for collecting hormonal data. When ready to analyze the saliva, it will be placed in wells and the hormones from the saliva will bind to the base of the wells. Next, the wells will be optically examined and this process will reveal the amount of testosterone, cortisol, or estradiol in your saliva.

At the beginning of the study, we will measure your bicep circumference and grip strength. Then you will be asked to complete brief questionnaires about demographics, beliefs about conflict, and mood. Next, you will be paired with another participant and will have the opportunity to earn money on a computer task involving a strategic decision-making. After completing this computer task, you will complete a short questionnaire assessing your thoughts on the task. At the end of the task, we will also take a photograph of your face posed in a neutral expression (like a passport photograph) so that we can later measure the underlying bone structure of your face. See Model Consent form for more details. The study takes approximately 60 minutes to complete. Based on the nature of the task, certain individuals who significantly lack manual dexterity may be ineligible to participate in the study.

POTENTIAL BENEFITS AND RISKS

Possible benefits of participation include earning money based on strategic decision-making and the opportunity to win $100 in a lottery. Also, participation in this task may benefit the scientific community by adding to the developing knowledge on the relationship between hormones, strength, beliefs about conflict, facial structure, and strategic decision-making. Due to the nature of the computer task there is a slight risk that participation may lead to wrist strain.

CONFIDENTIALITY

Although your name will be associated with the raw data collected in the study, you will not be identified individually in any way in written reports of this research. Data collected during this study will be stored in a locked file cabinet in Dr. Cheryl McCormick's laboratory. This raw data, containing identifying information, will be kept for 5 years after which time all data will be shredded and disposed. Saliva samples, once analyzed, will be disposed of according to the Research Ethics Board guidelines. Access to this data will be restricted to Shawn Geniole (Master's Thesis Student) and Dr. Cheryl McCormick (Professor). Datasheets used for statistical analyses, however, which will not include any personal identifying information, may be shared with other researchers or labs. Additionally, these data sheets may be reanalyzed following potential publication and will be kept indefinitely on password-protected computers in Dr. McCormick's laboratory and may be used for other perception studies in which additional participants provide ratings of the face on various characteristics (e.g. aggression, nurturing, babyishness, etc.). See the Model Consent form for more details.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty regarding research credits. However, if you wish to withdraw prior to the strategic game, you will receive no financial compensation. Additionally, if you withdraw during the strategic game, you will receive a pro-rated amount of money based on your performance prior to withdrawal. Any withdrawal will result in the termination of data collected.

PUBLICATION OF RESULTS

Results of this study may be published in professional journals and presented at conferences. Further, data may be shared with other researchers or labs, but will only be identifiable via identification numbers (no personal information will be linked to the data). Additionally, data may be reanalyzed following potential publication. Feedback about this study will be available from Shawn Geniole. If you wish to learn about the results of the study, you may contact him at sg06qo@brocku.ca.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact the Principal Investigator or the Faculty Supervisor using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University (10-087). If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca. Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive

any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: _____

Signature: _____ Date: _____

Email (if you wish to be contacted for future studies or re-consent for reanalysis of data): _____;_____;_____

This study is supported by a Social Sciences and Humanities Research Council (SSHRC) grant to Dr. Cheryl McCormick.

Appendix C. Study 1 Model Consent Form

Model Consent Form

I grant permission for Dr. Cheryl McCormick and her students and assistants to take and use my photograph for scientific research. I understand that my photograph may be digitally altered in numerous ways and that research participants may view my photograph in its original and altered forms. Research participants may also rate my photograph on various attributes (e.g., aggression, masculinity/femininity, attractiveness, nurturing, babyishness, etc).

I grant permission for Dr. McCormick and her students and assistants to use and reuse photographs of myself in original and altered forms. I understand that my name will not used in conjunction with my photographs, to ensure my confidentiality.

I am aware that I can withdraw from having my photograph taken at any time. I am also aware that no known physical or psychological harm or discomfort will result from my photograph being taken.

I have read the above and understand the terms and conditions described. I agree to have my photograph taken and used as described above.

Name (print) _____ Date of Birth _____

Signature _____ Date _____

-OR-

I agree to the above except I would only like for my photograph to be used in the current study and not to be shown in future studies.

Name (print) _____ Date of Birth _____

Signature _____ Date _____

-OR-

I do not wish to be photographed for this study. I understand that I will still receive the same number of research credits despite not participating in this "photograph" portion of the study.

Name (print) _____ Date of Birth _____

Signature _____ Date _____

Appendix D. Post-PSAP Questionnaire

Participant ID:

POST-PSAP QUESTIONNAIRE

a) How much did the other participant steal from you?

hardly any points		average amount of points		a lot of points
-2	-1	0	1	2

b) How provoking (i.e. aggravating, frustrating) was the other participant?

Not at all provoking		somewhat provoking		extremely provoking
-2	-1	0	1	2

c) What were your thoughts about your competitor? While playing, did you form an impression of your competitor, either a positive or a negative impression? If so, please describe your impression in a sentence or two.

_____
_____
_____
_____
_____
_____

d) General comments

_____
_____
_____
_____

Appendix E. Psychological Threat Potential Questionnaires

1. Anger Proneness

	strongly disagree — strongly agree
1. Although I don't necessarily act on it, I feel an urge to punch people who think they are better than me.	1----2----3----4----5----6----7
2. People who get in my face bug the hell out of me.	1----2----3----4----5----6----7
3. It really bothers me if someone has gotten away with something at my expense.	1----2----3----4----5----6----7
4. If someone insults me I just let it pass.	1----2----3----4----5----6----7
5. If another driver cuts me off, I do not get angry.	1----2----3----4----5----6----7
6. It is harder to get me angry than other people.	1----2----3----4----5----6----7
7. Some people just need to be taken down a peg or two.	1----2----3----4----5----6----7
8. If someone shoves me I shove back.	1----2----3----4----5----6----7
9. If someone was making too much noise in a movie theater, and ruining it for the rest of us, I would tell the loudmouth to shut up.	1----2----3----4----5----6----7
10. I don't back down.	1----2----3----4----5----6----7
11. I have a short fuse.	1----2----3----4----5----6----7
12. I get very angry when someone makes fun of me.	1----2----3----4----5----6----7
13. If someone insults me, I usually don't say anything about it.	1----2----3----4----5----6----7
14. If someone gets in my face, I tell them to back off.	1----2----3----4----5----6----7
15. If someone hurts my feelings I usually let it pass.	1----2----3----4----5----6----7
16. If someone cuts in line in front of me, I let it pass.	1----2----3----4----5----6----7
17. I usually shrug it off when a stranger causally insults me.	1----2----3----4----5----6----7
18. Sometimes I get so mad I feel like I'm going to burst.	1----2----3----4----5----6----7
19. People act like jackasses all of the time.	1----2----3----4----5----6----7
20. People often irritate me.	1----2----3----4----5----6----7
	much less — much more
21. Rate how much of a temper you have (compared to your same sex friends).	1----2----3----4----5----6----7

2. Entitlement & Success in Conflict

	strongly disagree	strongly agree
1. I deserve to have a good life.	1----2----3----4----5----6----7	
2. I don't deserve any more than anyone else.	1----2----3----4----5----6----7	
3. Most people are better than me.	1----2----3----4----5----6----7	
4. What I earn in life is mine, and I shouldn't be forced to share it.	1----2----3----4----5----6----7	
5. I am better than most people.	1----2----3----4----5----6----7	
6. I deserve more than the average person.	1----2----3----4----5----6----7	
7. I deserve less than the average person.	1----2----3----4----5----6----7	
8. I feel uncomfortable taking the last soda when in a group of people.	1----2----3----4----5----6----7	
9. I feel uncomfortable when I get awards because other people might be jealous.	1----2----3----4----5----6----7	
10. I usually feel nervous when I'm late for a meeting or appointment with someone else.	1----2----3----4----5----6----7	
11. People get too upset with me when I do minor things.	1----2----3----4----5----6----7	
12. I feel uncomfortable saving seats for people at the movie theater when it's really crowded.	1----2----3----4----5----6----7	
13. When people offer to do me a favor I often refuse because I would be uncomfortable imposing on them.	1----2----3----4----5----6----7	
14. I sometimes feel uncomfortable when I'm given praise.	1----2----3----4----5----6----7	
15. I feel as although I need to come out on top in any confrontation.	1----2----3----4----5----6----7	

	strongly disagree		strongly agree
1. If I want something, I can usually get it even if others don't want me to have it.	1----2----3----4----5----6----7		
2. Other people know not to get in my way.	1----2----3----4----5----6----7		
3. If another person and I both want something, I will be more likely to get it.	1----2----3----4----5----6----7		
4. People generally do what I ask them to do.	1----2----3----4----5----6----7		
5. I don't have much of a problem getting people to do what I want them to do.	1----2----3----4----5----6----7		
6. I can't get people to do what I want them to do.	1----2----3----4----5----6----7		
7. When there's a dispute, I usually get my way.	1----2----3----4----5----6----7		

3. Belief about the Utility of Aggression

	strongly disagree	strongly agree
1. If I don't respond to provocations and do something to make wrong-doers pay, they'll just do more to hurt me in the future.	1----2----3----4----5----6----7	
2. If someone gets out of line with me, I think it is better to let it pass.	1----2----3----4----5----6----7	
3. If someone hurts me, and I do something back to make them pay, they'll just do more against me.	1----2----3----4----5----6----7	
4. It's not worth my time or effort to pay back someone who has wronged me.	1----2----3----4----5----6----7	
5. If someone does something to hurt me, and I don't get them back, then they'll think they can do whatever they want to me.	1----2----3----4----5----6----7	
6. Sometimes, you just have to settle things with physical force.	1----2----3----4----5----6----7	
7. A wise person avoids competition.	1----2----3----4----5----6----7	
8. You have to stand up for yourself by confronting people with what they've done.	1----2----3----4----5----6----7	
9. You should not back down when someone threatens you; if you do back down the person will continue to take advantage of you.	1----2----3----4----5----6----7	
10. Words can solve most problems better than violence.	1----2----3----4----5----6----7	
11. If I were to use force to solve my problems it would only cause more problems for me in the long run.	1----2----3----4----5----6----7	
12. If I don't fight back, people will walk all over me.	1----2----3----4----5----6----7	
13. When it comes to one-on-one confrontations, violence never solves anything.	1----2----3----4----5----6----7	
14. Violence can solve problems for me.	1----2----3----4----5----6----7	
15. Confronting people scares me.	1----2----3----4----5----6----7	
16. It makes me nervous to voice strong disagreement.	1----2----3----4----5----6----7	

Appendix F. Money Allocation Question

Please indicate the amount of money you would like your opponent to be paid by putting a slash in the line below.

$0 $5

Appendix G. Study 2 Consent Form

Date: September 1st, 2016
Project Title: Examining personality, facial structure, and personal preferences

Principal Investigator
Cheryl McCormick, PhD
Professor
Psychology
Brock University
905-688-5550 ext 3700
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Principal Student Investigator
Elliott MacDonell
MA Student
Psychology
Brock University
905-688-5550 ext 3959
em10zc@brocku.ca

INVITATION
The purpose of this study is to investigate the inference of personality characteristics, formed from snap judgements of photographs of faces.

WHAT'S INVOLVED
You will rate faces on a variety of characteristics, and then you will complete a demographic questionnaire. The study takes approximately 30 minutes to complete.

POTENTIAL BENEFITS AND RISKS
Also, participation in this task may benefit the scientific community by adding to the developing knowledge on the relationship between snap judgements, personality, and facial structure.

CONFIDENTIALITY
Although your name will be associated with the raw data collected in the study, you will not be identified individually in any way in written reports of this research. Data collected during this study will be stored in a locked file cabinet in Dr. Cheryl McCormick's laboratory. This raw data, containing identifying information, will be kept for 5 years after which it will be shredded and disposed. Access to this data will be restricted to Elliott MacDonell (MA candidate) and Dr. Cheryl McCormick (Professor). Datasheets used for statistical analyses, however, which will not include any personal identifying information, may be shared with other researchers or labs. Additionally, these datasheets may be reanalyzed following potential publication and will be kept indefinitely on password-protected computers in Dr. McCormick's laboratory.

VOLUNTARY PARTICIPATION
Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty regarding research credits. Any withdrawal will result in the shredding, disposal, and deletion of any data or photograph collected.

PUBLICATION OF RESULTS
Results of this study may be published in professional journals and presented at conferences. Further, data may be shared with other researchers or labs, but will only be identifiable via

identification numbers (no personal information will be linked to the data). Additionally, data may be reanalyzed following potential publication. Feedback about this study will be available from Elliott MacDonell. If you wish to learn about the results of the study, you may contact him at em10zc@brocku.ca.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact the Principal Investigator or the Faculty Supervisor using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University (14-061). If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca. Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: _____

Signature: _____ Date: _____

Email:
_____;_____;_____

This study is supported by a Social Sciences and Humanities Research Council (SSHRC) grant to Dr. Cheryl McCormick.